# Metals Review



# Metals Review

**The News Digest Magazine**

**July 1957**

**Volume XXX, No. 7**





***Published monthly by the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio: D. S. Clark, President; G. M. Young, Vice-President; C. H. Lorig, Treasurer; W. H. Eisenman, Secretary; G. E. Shubrooks, H. A. Wilhelm, G. A. Fisher and Carl E. Swartz, Trustees; A. O. Schaefer, Past President. Subscriptions $5.00 per year ($6.00 foreign). Single copies $1.00. Entered as Second Class Matter, July 26, 1930 at the Post Office at Cleveland, Ohio, under the Act of March 3, 1879.***

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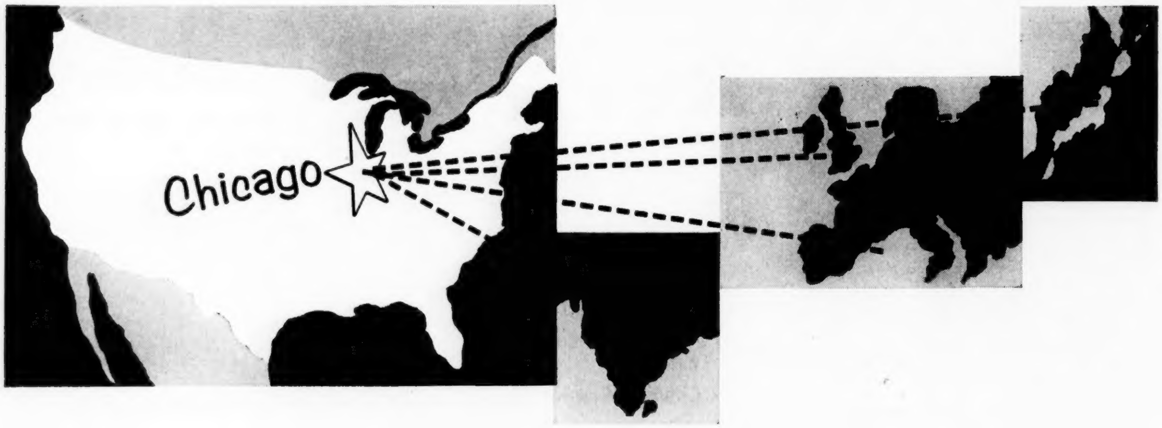
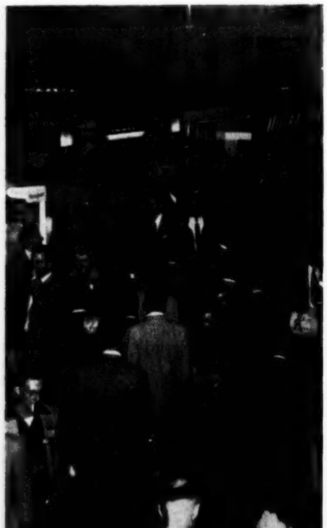



# 39th National Metal Exposition
# 2nd World Metallurgical Congress



In the whole, wide, wonderful world of metals, for one fast-moving, action-packed week, Chicago will be world headquarters for metal men.

From wherever metals are made . . . from wherever metals are used . . . from all parts of the United States and around the free world, the responsible men of metals will move into Chicago the week of November 4, 1957.

Engineers and scientists . . . executives and production experts . . . the responsible men of metals will be in Chicago to see the 39th National Metal Exposition — the best, the biggest, the most important Metal Show of them all. Hundreds of manufacturers will place their best products and operating processes and equipment on display in the vast International Amphitheatre and New Exposition Halls. This great Exposition will make show history . . . will make metals history.

And this is only half the story. World authorities on metals . . . outstanding scientists from the United States . . . again, the responsible men of metals will be speakers at the 2nd World Metallurgical Congress and at the 39th National Metal Congress. Technical and practical sessions will begin on Saturday, November 2, and run continuously through Friday, November 8. Never before has such an array of metals engineering and scientific talent been assembled on so vast a scale . . . engineering developments of world-wide impact will be presented for all to hear and digest and discuss.

You will want to attend this great event, this world metals week in Chicago. Your organization may well wish to send management, engineering and sales representatives. Make the first move now — write for hotel reservation forms.

**AMERICAN SOCIETY FOR METALS**

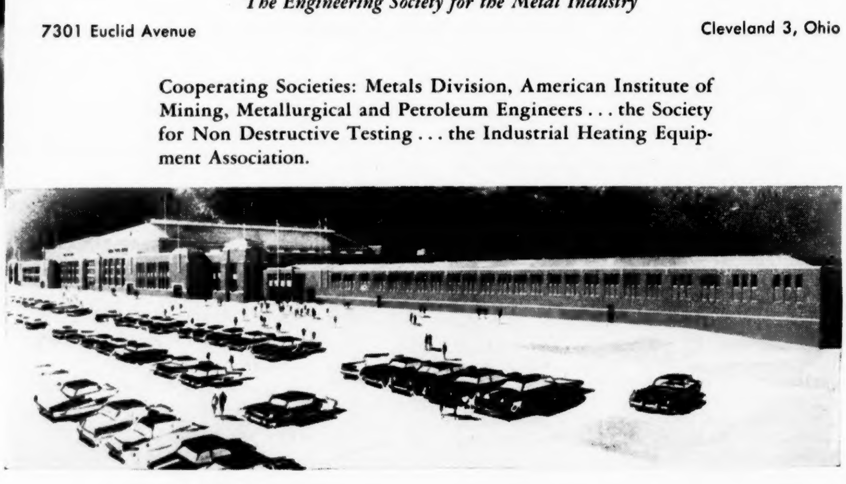
*The Engineering Society for the Metal Industry*

7301 Euclid Avenue Cleveland 3, Ohio

Cooperating Societies: Metals Division, American Institute of Mining, Metallurgical and Petroleum Engineers . . . the Society for Non Destructive Testing . . . the Industrial Heating Equipment Association.

## Exhibit Space Available

**Hundreds of manufacturers have reserved Metal Show space, but there are good locations still available in the vast new exposition halls of the International Amphitheatre. If the metalproducing or metalworking industries are your market, don't miss this show — write for display information now.**



# Roberts Elected Metal Powder President

*George A. Roberts (Right), Vice-President—Technology, Vanadium-Alloys Steel Co., and Past President A.S.M., Was Elected President and Board Chairman of the Metal Powder Association at the 13th Annual Meeting Held in Chicago. He is being congratulated by Kempton H. Roll, immediate past chairman of New York Chapter A.S.M., who has been appointed the first full-time executive secretary and treasurer of the Association*

George A. Roberts, already well known to the members of the American Society for Metals, which he served as president in 1954-55, will further widen his familiarity with metals and the metals industry as a result of his appointment as president and board chairman of the Metal Powder Association. This appointment, as well as that of Kempton H. Roll, past chairman of the New York Chapter A.S.M., was announced at the Association's Annual Meeting held recently in Chicago.

Vice-president—technology, Vanadium-Alloys Steel Co., Dr. Roberts' enthusiasm for any task he undertakes is an established factor in his being chosen so frequently as the man to "do a job" which requires youth, honesty and courage, not to mention a well-rounded background in his profession.

George received his B.S. degree in metallurgy from Carnegie Institute of Technology in 1939, and remained as a teaching assistant in physical metallurgy and ferrous metallography until he was granted his M.S. degree in 1941. He joined Vanadium-Alloys in 1940 as a research metallurgist, returning to Carnegie Tech as a Vanadium-Alloys graduate fellow to earn his Ph.D. degree, granted in 1942. He had spent two years at the United States Naval Academy, leaving because his vision dropped below acceptable standards, prior to his first term at Carnegie.

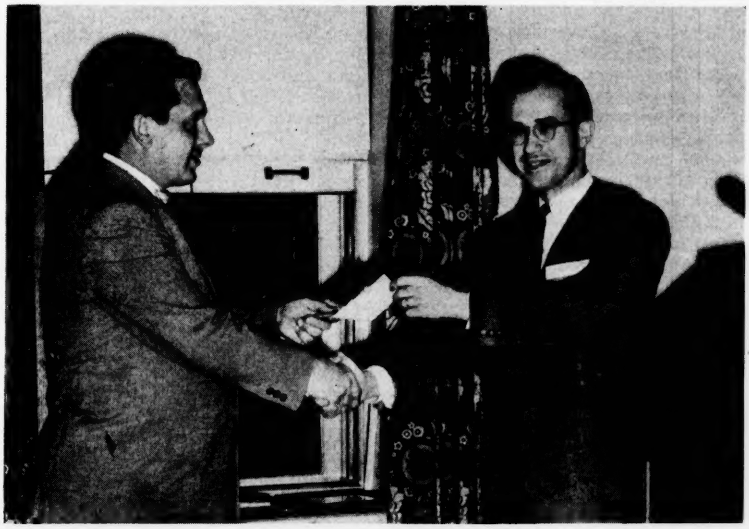
Dr. Roberts was promoted to chief metallurgist by Vanadium-Alloys and subsequently to vice-president—technology, his present position, in 1953. He is the author of numerous papers on subjects ranging from inhomogeneity in austenite and its effect on hardenability, to the metallurgy of toolsteels and of pre-alloyed steel powders. He is co-author of the book "Tool Steels", published by A.S.M. in 1946. He is credited with being in a large measure responsible for the development of the high-vanadium, high-carbon toolsteel, Super Hi Speed, at Vanadium.

Long active as a member of the American Society for Metals, Dr. Roberts has served as chairman of the Pittsburgh Chapter, a member of the national Publications Committee, a member of the Board of Trustees and the Society's vice-president.

He was born in Uniontown, Pa., spending most of his boyhood in Pt. Marion, Pa., where his father was a school superintendent and his mother an organ and piano instructor, the latter fact no doubt accounting for his ability to be at home at the keyboard. He and his wife, the former Betty Mathewson, have three children, two boys and a girl. Dr. Roberts shares their activities by helping them in their attic laboratory and in their scouting and Little League baseball activities.

Dr. Roberts looks forward to this coming year as one of anticipated great gains in the metal powder industry and has expressed his desire to help in furthering these gains as president of the Association.

# Awarded Prize for Photomicrograph



*The Highlight of the Students Night Meeting Held by the Philadelphia Chapter Recently Was the Presentation of Prizes to the Winners of the Photomicrograph Contest, Which Is Run Each Year for Students Only. Norman Brown, associate professor, metallurgical engineering, University of Pennsylvania, presented a talk on "Plastic Strength of Metals". Shown is Steven Buzash (left) receiving first prize for his photomicrograph from Conrad Knerr. Second prize went to E. D. Gregorewski, La Salle College; third prize was awarded to Eugene Deegan, Drexel Institute. Mr. Buzash is a student at Temple University. (Reported by H. A. Foy)*

# Report From Southern Metals Conference


*Shown at a Meeting Held During the Southern Metals Conference Are a Group of Representatives From the Naval Air Station Overhaul and Repair Department, Pensacola, Fla., Discussing With National Officers Plans to Set Up an A.S.M. Chapter at Pensacola. Included are, standing, from left: National President Donald S. Clark; Secretary W. H. Eisenman; and Harry J. Huester, Jacksonville Chapter; and seated, from left: Fred J. Miklas, Eli F. Nicosia and John T. Manning, all from Pensacola Naval Air Station*

The Jacksonville Chapter was host to the sixth annual Southern Metals Conference held recently, which drew the best attendance in its history. Representatives and members from the ten participating chapters (Birmingham, Carolinas, Chattanooga, Georgia, New Orleans, Oak Ridge, Savannah River and Old South) and others from all over the country attended. The theme of the conference was "New Horizons".

The technical sessions were divided into four parts over the three-day period, and covered discussions on metals and methods used in supersonic aircraft, nondestructive testing, physical testing, aluminum dip brazing, nitriding, welding, nuclear and other forms of metallurgy. Donald S. Clark, national president, the keynote banquet speaker, presented a talk entitled "New Horizons in Engineering Education", reported below.

A highlight of the conference was a tour of the Naval Air Station Overhaul and Repair Department, Jacksonville, the largest diversified metalworking facility in the South. The tour was preceded by a luncheon and an address by George Black, president, The George Black Co., on "New Horizons for Engineers".

Horace C. Knerr, president, Metlab Co., was host at the cocktail party prior to the banquet. Dr. Clark was introduced by W. H. Eisenman, national secretary, and Mr. Eisenman spoke briefly on "New Horizons of the A.S.M.", mentioning some of the plans for the A.S.M. of Tomorrow, concluding with a report of the national activities of the Society.

Harry J. Huester was conference chairman and Mrs. Huester was chairman of the ladies program, which included a yacht trip on the St. John's River with luncheon aboard, a day at Ponte Vedra Beach, luncheons, coffee and a cocktail party.—**Reported by Al Masterson for Jacksonville.**

## Clark on Education

Donald S. Clark, president A.S.M., who presented the keynote address at the Southern Metals Conference, said that inclusion of more science and mathematics in the educational programs for American school children could provide the necessary background and incentive for more young people to choose an engineering profession.

A recent survey has shown that approximately 200,000 18-year olds each year are qualified for college, but are not going. From 60,000 to 100,000 of these youngsters are not going because of financial reasons. The other 100,000 are not going because of their lack of interest or motivation.

Studies show that about 50,000 potential engineers and scientists are being lost each year because many of them are being discouraged against taking the prerequisite preparatory courses while in high school.

One reason young people are not choosing technical careers is because there has been a change in the hero-worship pattern from figures like Edison, Steinmetz and Ford to movie stars, athletes and "Elvis Presleys".

An even more important factor, according to Dr. Clark, is that of family opinion, including views on elementary education, opposition to homework and a general inclination to let life take its course.

The United States should not be too much concerned because Russia is producing more engineers and scientists than we are just because Russia is doing something faster than we are. The United States should consider just what Russian motives are and make certain this nation is not making the fatal mistake of just copying them; we should look at our own problems and solve them.

The demand and recognition for those who can do real thinking is increasing. In urging the liberalization of current school programs, Dr. Clark said such a move could stimulate the minds of young people to think of a career in some scientific field.

What we must do, he said, is to have a nationwide awakening to the great need for thinking men, not only for the need of more engineers and scientists but the need for knowledge by everybody.

Some people, and unfortunately too many, have the idea that mathematics and science are narrow, technical and vocational subjects. They have the idea that the humanities and social sciences are the only liberal and broadening subjects that should be taught. This is not true. All of these subjects form a proper part of a liberal education, but we must think in terms of all people having a broad training or liberal education, which includes math and science as well as the humanities and social studies.

He pointed out that we should all make certain that our young people receive at least a liberal education; that is, basic courses in literature, history, government, mathematics and science. If we will only do this, we will be able to recognize much quicker those who have capacities in the field of engineering and sciences and those who have greater capacities in the humanities or social sciences. We can then put them on the track in the fields in which they will probably have greatest interest and pleasure and in which they will do the best possible job.

## Panel Reports on Nuclear Power at Santa Clara Valley

A panel discussion on "Nuclear Power—New Challenge for Metallurgists" was presented by B. R. Elder, M. J. Sanderson and W. R. Smith, all members of the atomic power equipment department of the General Electric Co., at a meeting held recently by the **Santa Clara Valley Chapter.** They discussed the technical problems associated with the use of fission energy, the criteria for the selection of materials for a nuclear power plant, and reviewed the fabrication and manufacturing problems peculiar to the materials and equipment faced by the nuclear power industry.—**Reported by H. T. Sumsion for Santa Clara Valley.**

## Describes Effect of Heat Treatment on Properties Of Metals at Penn State

Speaker: R. A. Grange

*U. S. Steel Corp.*

At a recent meeting of the **Penn State Chapter,** R. A. Grange from the Edgar C. Bain Laboratory for Fundamental Research, U.S. Steel Corp., spoke on "Heat Treatment, Its Effect on Metals".

Mr. Grange divided heat-treatable metallic systems into five classes: pure metals; solid-solution alloys; precipitation-hardening alloys; pure metals which undergo allotropic changes in the solid state; and alloys which undergo allotropic changes in the solid state.

He explained, briefly, the methods by which these systems are heat treated, and then went on to a more thorough discussion of the methods of heat treating steels.

Steel is an example of an alloy which exhibits two phases in the solid state. The temperature at which the eutectoid transformation takes place can be controlled, and by varying the temperature of this transformation, the properties of steel are controlled.

It is the high solubility of carbon in the face-centered structure of iron as compared to the low solubility in the body-centered structure which makes possible the wide and varied properties of steel.

Mr. Grange outlined four types of heat treatments which are particularly suited to steel:

1. Normalizing treatment, wherein the steel is heated into the austenitic field and air cooled to produce ferrite, pearlite, and bainite.
2. Conventional annealing, wherein the steel is furnace cooled from the austenitic region to produce ferrite, pearlite and bainite.
3. Isothermal annealing, wherein the steel is quenched to some temperature, and the transformation is allowed to take place at that temperature.
4. Spheroidizing annealing, wherein the steel is held just below the $A_1$ temperature, or the temperature is varied from just above to just below the $A_1$ temperature.

There are several methods by which a hardened structure may be obtained in steel. Briefly, they are (a) quenching to produce a martensitic structure, then tempering to restore ductility and to gain toughness; (b) marquenching and tempering; and (c) austempering.

Mr. Grange called attention to the dangers of stresses which may arise in steels as a result of rapid quenching. The exterior of a quenched piece of steel is in tension with the center in compression. This leads to dimensional instability which may cause the piece to crack.

Mr. Grange completed his talk by giving the reasons for heat treatments. The steelmaker treats the steel in various ways to gain a desirable combination of hardness, ductility, yield strength and toughness which are required in the steel for its particular application.—**Reported by Donald A. Toland for Penn State.**

## *Fast Heating Discussed at Rockford*

*Charles A. Turner, Jr., Selas Corp. of America, Spoke on the "Metallurgical Aspects of Fast Heating" at a Meeting in Rockford. Shown are, from left: D. A. Campbell, chairman; Mr. Turner; and Q. Bowen, vice-chairman*

Speaker: C. A. Turner, Jr.

*Selas Corp. of America*

Charles A. Turner, Jr., Selas Corp. of America, presented a talk on "Metallurgical Aspects of Fast Heating" at a meeting in **Rockford.**

The highly competitive nature of modern business and other economic pressures has forced management to place increasing emphasis on cost reduction as a major goal for a successful operation. This consideration has led to improvement and modernization of equipment and processing throughout the entire field of manufacturing operations.

This trend in recent years has caught up with the heretofore neglected heating and heat treating departments, so that today faster heat processing involving principles of automation has provided important economic changes.

Some of the characteristic advantages of fast heating methods are reduced inventory with fewer parts in process and reduced rejects by elimination of the human element from control and the tie-in with production line operations.

Fast heating is the rapid heat transfer rate developed by the combustion of air and gas in special ceramic burners with temperatures to 3000° F.

For localized heating and heating of thin metals, the time interval is in seconds and for heating billets and bars, the time interval is in minutes. In all cases, the heating time is substantially lower than that of conventional practice.

By conventional heating methods the peak furnace temperature is limited by the required peak temperature of the charges. This necessarily restricts the heating rate (i.e., a 1-in. bar will reach a temperature of 1600° F. in 12 min. when placed in a 1600° F. furnace, in 80 sec. when subjected to a 2500° F. furnace heat, and in 45 sec. when subjected to a 3000° F. heat).

Many commercial heating furnaces are capable of developing a 2500° F. temperature head. However, their design and positioning of the charge on the hot hearth leads to extreme temperature variations over the exposed surfaces which prevent attainment of a sound product. Hence, the usual practice is to place the charge on the hearth of a preheated furnace, at reduced temperature, and bring the furnace and charge slowly up to peak temperature. A long soaking period follows, aimed at a uniform heat throughout the charge.

In fast heating the heat source is compacted and patterned so that the workpiece is completely surrounded by the high-temperature medium. In addition, the element of precise control is provided which results in a uniformity of heat effect on successive pieces handled singly or in a continuous production line.—**Reported by Joseph F. Sisti for Rockford Chapter.**

**As an indication of the tremendous dissemination of engineering information, a compilation shows that in one year the A.S.M. collected, edited, published and distributed over *one hundred million pages* of metallurgical information.**

# *Carolinas Holds Meeting for Students*


*At a Meeting of the Carolinas Chapter Held at North Carolina State College, Gerhard Derge, Jones & Laughlin Professor, Metallurgical Engineering, Carnegie Institute of Technology, Spoke on the "Training of Metallurgists". Shown are, from left: Dr. Derge; W. W. Austin, head, minerals department, North Carolina State College and faculty sponsor of State's Student Chapter; and A. R. Fairchild, past chairman of the Chapter*

Speaker: Gerhard Derge

*Carnegie Institute of Technology*

A recent meeting of the **Carolinas Chapter,** held in conjunction with the Engineers' Fair at North Carolina State College, featured a talk on the "Training of Metallurgists" by Gerhard Derge, Jones & Laughlin Professor, metallurgical engineering, Carnegie Institute of Technology.

Dr. Derge traced the careers of ten anonymous former students, several of whom were so outstanding that most of the older members recognized them immediately. Dr. Derge then went on to describe the modern fields of metallurgy but made the point that, historically, men with metallurgical training were more inclined to stay within their chosen fields than were other types of engineers. This was true even of men who had reached the top management levels. Dr. Derge stated that this trend goes back to the ancient blacksmiths who were men who spoke with authority in their communities as they were so scarce and yet so necessary to their society.

Dr. Derge closed by complimenting the Carolinas Chapter for its efforts to further the needs of educators to educate the metallurgists of the future.

Attending this meeting were 14 members of the North Carolina State College Student Chapter and 8 members of the Virginia Polytechnic Institute Student Chapter, as well as 14 high-school boys who attended as personal guests of some of the members.

J. H. Lampe, dean of engineering at State, who gave the coffee talk, discussed the problem of staffing engineering schools in today's competitive market for men of teaching caliber, emphasizing the problems of Land Grant Colleges as opposed to privately endowed schools.

Past-chairman A. R. Fairchild presented a scholarship certificate during the evening to Martin Luther Townsend, Jr., who holds an A.S.M. Scholarship at State. The Carolinas Chapter supports A.S.M. activity at State by turning over to W. W. Austin, head of the minerals department, half of all income received by the chapter from sustaining memberships. In honor of their support to this program, V. Vierling, membership chairman, presented sustaining membership certificates to W. W. Austin, A. R. Fairchild, J. J. Hairston and S. P. Schwoyer, who have changed their memberships from individual to personal sustaining.—**Reported by A. F. Engelberg for Carolinas Chapter.**

## Discuss Jet Engines and Metallurgical Control at Jacksonville Meeting

Speakers: W. E. F. Zepke and J. M. Edge

Walter E. F. Zepke, staff engineer on construction of test facilities, Pratt & Whitney Aircraft, told members of the **Jacksonville Chapter** that his company's aircraft jet engines power a large percentage of all operational supersonic fighters in the country's air arsenal, and they are the power plants for the nation's strategic air weapon—the Boeing Bomber B52—as well as future commercial airlines such as the Boeing 707 and the Douglas DC8. He mentioned other vital materials, such as titanium, saying that nearly one-half of the company's current compressor production now has disks made from titanium. Pratt & Whitney depends greatly on many of Jacksonville's steel plants for fabricating the major parts of their test stands.

Sharing the program was J. M. Edge, manager, department of metallurgy, inspection and research, TCI Division, U. S. Steel Corp. He stated that metallurgical control is not intended to describe the efforts of a specialized group to technicians, but rather a fund of knowledge that is generally shared by all who are charged with the responsibilities of producing a quality product at a reasonable cost in sufficient quantity and at the required time to meet the customer's needs.

After the technical session, Harry J. Huester, Naval Air Station, was presented a 25-year pin for his long and faithful service to the Society, and student awards were presented to Paul Halyard and Edward McKinley, mechanical engineering students and laboratory assistants in metallurgy at the University of Florida, by Loel L. Judy. Chet Shira conducted the meeting which was held at the Parker & Mick Welding & Machine Works.—**Reported by Harry J. Huester for Jacksonville.**

## Describes Improvements In Tool and Die Steels

Speaker: S. G. Fletcher

*Latrobe Steel Co.*

Stewart G. Fletcher, director of metallurgy at Latrobe Steel Co., spoke in **Albuquerque** on "Modern Developments in Tool and Die Steels".

Dr. Fletcher cited three major areas of improvements made in tool and die steels in the last ten years. These areas included:

1. Improvement in steel compositions resulting from increase in vanadium content for improved wear resistance and increase in sulphur content for machinability.
2. Improvements in heat treatment resulting from better heat treat furnaces, better pyrometry and predictable control of grain size.
3. Improvements in steel quality through tightened limits in chemical composition, use of ultrasonic inspection and controlled segregation.

Dr. Fletcher also briefly discussed the AISI code designations for steel compositions.

Following the address, a motion picture entitled, "The Heart of the Matter" was shown. The film depicted the various aspects of toolsteel manufacture including quality control.

# Cincinnati Host to Tri-Chapter Meeting

The Cincinnati Chapter was host to the annual Tri-Chapter Meeting held by the **Cincinnati, Columbus and Dayton Chapters** at General Electric's Evendale plant in April.

After the welcoming remarks by host chairman M. C. LaBau, and D. C. Berkey, assistant to the general manager of the Flight Propulsion Laboratory, an interesting roster of speakers was presented by program chairman A. E. Focke, past national president A.S.M.

G. A. Moudry, technical director, Harvey Machine Co., spoke on "Extrusion of Metals". He pointed out that the two most distinct advantages of extrusions are optimum configuration and superior mechanical properties. He discussed the conditions necessary to extrude aluminum, titanium and steel as well as some of the new elevated temperature stainless alloys.

O. E. Cullen, chief metallurgist, Surface Combustion Corp., presented a talk on "Recent Developments in Atmosphere Control of Ferrous Metal Heat Treating". He covered the wide variety of atmospheres produced today for protection purposes as well as controllable chemical reactions. He displayed diagrams illustrating the production of both exothermic and endothermic gases and pointed out the necessity of controlling minor constituents where carbon control is desired.

The two methods of controlling carbon in a controlled atmosphere furnace, the infrared method for measuring $CO_2$, and the dew cell measurements of $H_2O$ vapor which is indirectly related to the $CO_2$ in the atmosphere, were also described by the speaker.

Mr. Cullen referred briefly to the use of carbon restoration in gears, forgings, rolled threads and ball bearings.

The "Electric Ingot Process" was discussed by R. K. Hopkins, manager, electric products department, M. W. Kellogg Co. The "Pluramelt" and "Electric Hot Top" processes and their development were described. He pointed out that the electric hot topping process eliminates ingot pipe. In the electric ingot process a strip is formed into tube, which becomes a consumable electrode in turn carrying the metered alloying elements. The electrode and alloying elements are deposited in a water-cooled copper mold employing a dry flux. Since progressive solidification takes place, there is no shrinkage cavity or segregation and the damping effect of the flux eliminates spatter. An egg shell of slag forms on the mold wall, resulting in better surface due to fewer cold shuts.

S. J. Whalen, president, Aerobraze Corp., spoke on some of the problems of "Brazing Alloys With the High Temperatures for Jet Engine Components".

Copper-base brazing alloys have a service temperature of about 900° F., but the Cr-Ni base alloys have service temperatures to 2000° F. He pointed out the uses and advantages of silicon-boron as well as the nickel-phosphorus brazing alloys. He further indicated the necessity for extremely close tolerances and dew point control of the dry hydrogen atmosphere used in brazing. He summarized by showing slides of industrial equipment used in brazing and the microstructures and physical properties that can be expected from proper brazing techniques.

F. N. DaMara, in a talk on "Vacuum Technology in Metallurgy", described the equipment and techniques of vacuum induction. Melting under low pressures allows another degree of thermodynamic freedom as well as types of reactions that are not ordinarily experienced in conventional atmosphere melting practices. The speaker emphasized the importance of the raw material and also the stirring action to provide deoxidation of the oxygen carried in by the metallic powders in the charge. With proper practice, extremely close melting specifications can be met and with vacuum melting of high-temperature alloys, such as Waspalloy, stress rupture life at 32,500 psi. and 1500° F. can be increased four to five times that of conventionally melted material.

A social hour and dinner was held at the Hartwell Country Club at the close of the formal meeting. W. J. Klayer of Aluminum Industries introduced M. C. Leverett who commented on "Aircraft Nuclear Propulsion". Ed Herschede, Jr., of the Cincinnati Genealogical Laboratory, presented an interesting discussion on "Gems and Their Evaluation".

There were 250 members of the three chapters in attendance, with 55 from Dayton, 30 from Columbus, and 165 from Cincinnati Chapter.

Walter Koshuba, the general chairman, and his staff from the Cincinnati Chapter and the General Electric Co., did an excellent job of arranging the meetings as well as providing five selected tours through the Evendale plant. — **Reported by J. H. Timmers for Cincinnati.**

## *Stamp Commemorates the Steel Industry*

*A Stamp Commemorating the Steel Industry in America Was Issued by the U. S. Post Office in May in Honor of the 100th Anniversary of the Kelly Patent, Entitled "Improvements in the Manufacturing of Iron", Granted in 1857 to William Kelly of Kentucky. The Kelly process, once referred to as the pneumatic or air-boiling method, is now generally known as the Bessemer process after Henry Bessemer of England, who was first to reach the patent office. There are many in the U. S. and England who feel that Kelly's work, begun in 1847, antedated Bessemer's effort and that some credit should be given to Kelly. The photograph shows a Kelly converter used in 1861-62 at Cambria Iron Works, Johnstown, Pa. The stamp will be available for a few months at most post offices*

## Worcester Presents Stamping Symposium

*Participants in the Stamping Symposium Held by the Worcester Chapter Were, From Left: H. D. Berry, Thomas Smith Co.; Carter C. Higgins, Worcester Pressed Steel Co.; Lincoln G. Shaw, Pratt & Inman, Chairman; Walter J. Nartowt, Greenman Steel Treating Co., Vice-Chairman; G. J. Shandrick, Lundquist Tool & Manufacturing Co.; and Roger C. Hager, Carroll Pressed Metal Co. Titanium, Progressive Dies, Blanking and Flat Forming of Heavy Ferrous Metal, and Supplementary Operations to Stamping were discussed. E. W. Talbot, Thomas Smith Co., moderated*

## Turns Over M.I.T. Scholarship Check

*James Martin, Watertown Arsenal, Is Shown Presenting the Boston Chapter Scholarship Fund Check to Morris Cohen, Massachusetts Institute of Technology, for the Metallurgy Student Scholarship Sponsored by Boston*

## New Haven Elects New Officers

*Officers for the 1957-58 Season Recently Elected by New Haven Chapter Include, From Left: F. E. Storm, Chase Brass and Copper Co., Treasurer; Kenneth L. Tingley, Scovill Manufacturing Co., Vice-Chairman; John M. Quinn, Bristol Co., Secretary; and Harold O. Seley, Remington-Rand, Inc., Chairman. (Reported by James L. Baker for New Haven)*

## MEN OF METAL

Richard E. Corcoran has been appointed product sales manager of wire and weld products for the parts division of Sylvania Electric Products, Inc. He is to be responsible for sales of the products of the Warren, Pa., and Nelsonville, Ohio, plants, with headquarters in Warren.

James DeKoker, formerly associated with Bronson & Bratton, Chicago, has been appointed cutting tool sales representative for General Electric Co.'s Metallurgical Products Department, with headquarters in Dallas.

Westinghouse Electric Corp. announces the appointment of W. J. Delaney, Jr., as head of a newly created X-Ray and Industrial Electronics Division, Baltimore. Mr. Delaney was formerly manager of the welding department in Buffalo.

James W. Dunham, vice-president, National Cylinder Gas Co., Chicago, has been elected president of Compressed Gas Association, Inc., in New York City.

Robert H. Eschbach has been appointed midwestern sales representative by Superior Tube Co. He will work with distributor representatives in 11 states, with headquarters in Chicago.

Wellman Bronze and Aluminum Co. has announced the appointments of Paul W. Hook, formerly treasurer and assistant to the president, as executive vice-president and treasurer, Glenn F. Ihrig, formerly general sales manager, to vice-president in charge of sales, Gene Faubel, formerly sales engineer, to assistant sales manager.

William Hagel, vice-president and executive assistant, United Engineering and Foundry Co., has been appointed vice-president in charge of operations, in which capacity he will be in charge of all manufacturing and production facilities. He will continue to supervise the company's estimating and sales contract departments.

E. F. Helminiak has joined Electro Metallurgical Co., a division of Union Carbide Corp., as sales engineer assigned to the Chicago district office.

Robert G. Hall has been appointed blast descaling representative for Pangborn Corp. He will work with the nation-wide district offices from headquarters in Hagerstown, Md.

Harold F. Hanssen was appointed plant manager of the Electric Alloy Steel Division, Howard Foundry Co. He has been with the company for 15 years.

## Men of Metal

Norbert C. Hodgson has been placed in charge of sales of Johnson corrugated cinder posts by Mackintosh-Hemphill Division of E. W. Bliss Co. His office will be at the Garrison Works in Pittsburgh.

Howard C. Holmes, an executive of Kaiser Aluminum & Chemical Sales, Inc., is on loan from his corporation as director of the Aluminum and Magnesium Division of the Business and Defense Services Administration, U. S. Department of Commerce.

Edwin L. Horsley, a member of the divisional sales staff in New York, has been appointed district manager for the Rome Manufacturing Co., Division of Revere Copper and Brass Inc., in the New York sales office.

Troy B. Hunt, who has been in charge of designing the reduction plant of Olin Revere Metals Corp., Omal, Ohio, has been named plant manager of the new addition.

Charles J. Strickler has been appointed section head of organic chemistry for Horizons Inc., research organization in Cleveland, Ohio.

E. W. Ruhe has been appointed Roll-Bond manager of the Western Brass Mills Division, Olin Mathieson Chemical Corp., East Alton, Ill.

Spencer Turbine Co. has appointed Robert W. Richardson and Norman S. Barnes as assistant sales managers, David H. Hunt as assistant chief engineer, and Karl A. Hedling as chief draftsman.

William C. Long will manage the new district sales office being opened by NRC Equipment Corp. in Detroit, to serve Michigan and the Fort Wayne and Toledo areas.

The Gas Machinery Co. announces the appointment of James E. Hovis as manager of the Industrial Furnace Division to direct engineering, manufacturing and installation of all Gasmaco furnaces.

Earl G.. Olsen, sales engineer and technical consultant, Lindberg Engineering Co., has been appointed manager of sales in Rochester, N. Y.

Edward M. Grady has been appointed assistant to the vice-president for sales of the Western Brass Mills Division of Olin Mathieson Chemical Corp.

Sam E. Robb, formerly sales representative in the New York City area, assumes new responsibilities as advertising supervisor in the advertising department of Wolverine Tube Division of Calumet & Hecla, Inc.

## *Milwaukee Group Visits Allis-Chalmers*

*Some 100 Members of the Milwaukee Chapter Visited the Manufacturing and Research Facilities of the Allis-Chalmers West Allis (Wisconsin) Works During a Recent Meeting. The group shown above is listening to an explanation of the operation of an X-ray diffraction unit by one of the company's research divisions' technicians. (Photograph by Allis-Chalmers)*

## *President Clark Visits North Texas*


*At the National Officers Night Meeting Held by North Texas Chapter, President Donald S. Clark, California Institute of Technology, Presented a Talk Entitled "What Do Dynamic Laboratory Tests Tell Us". He is shown, center, with A. S. Holbert, vice-chairman, left, and J. P. Fowler, chapter chairman, right. (Photograph by S. Maszy for North Texas)*

## *Reviews Flame Hardening in Ontario*


*J. Cunningham, Owner and Operator, Detroit Flame Hardening Co., Guest of Western Ontario at a Recent Meeting, Took "Flame Hardening" as His Subject. Rather than having a talk on the subject, a lively question and answer period was conducted. A film entitled "Principles of Heat Treatment" was shown. Present were, from left: B. Blair, past chairman; G. Halliday, technical chairman; Mr. Cunningham; R. Cyr, chairman; and B. McIntyre, vice-chairman. (Reported by Frank Miller for Western Ontario)*

# *Given Sauveur Award in Philadelphia*

*Walter Kinderman (Left), Chairman, Philadelphia Chapter, Is Shown Presenting the Sauveur Memorial Award to J. J. B. Rutherford, Babcock & Wilcox Co. Mr. Rutherford presented a talk entitled "Heat Treatment"*

Speaker: J. J. B. Rutherford
***Babcock & Wilcox Co.***

A recent meeting of the **Philadelphia Chapter** was held at the Franklin Institute in honor of Albert Sauveur. J. Winlock, chief metallurgist, The Budd Co., made a few remarks about Dr. Sauveur as he knew him. The Sauveur lecturer for this meeting was John J. B. Rutherford, chief metallurgist, The Babcock & Wilcox Co., who spoke on "Heat Treatment".

The speaker discussed the changes and advancements of metallurgy and heat treatment during the 30 years prior to 1926. During this period the microscope was first brought into use in identifying the constituents of steel. It was also during this time that gamma-iron was established as face-centered, and alpha-iron as body-centered cubic. In 1912 Dr. Sauveur published his book "The Metallography and Heat Treatment of Iron and Steel", and Jeffries and Archer published their ideas of age hardening by slip interference.

Mr. Rutherford went into the details of the struggle of the metallurgist to establish the facts of what happens during the heating and cooling of steel.

During the next 30 years, 1926 to 1956, the constituents of steel were identified through metallography and crystallography. The excellent metallographic techniques of Lucas and Vilella helped immeasurably to define the products resulting from phase changes and to establish an international community of agreement. Many unknown constituents were identified as disturbed metal or freak characteristics of etching.

Mr. Rutherford described the changes in quality and characteristics of steel since 1900. The subjects of heat treatment, corrosion, effects of high temperatures on steel, mechanical properties, welding and quality control were also discussed.

According to Mr. Rutherford, the field of metallurgy has broadened and, as the old saying goes, we know less and less about more and more and he stated that he hoped this is more apparent than real.

There can be no conclusion to a live topic. The master metallurgists are thinning out and are being replaced by teachers, administrators, and technicians.—**Reported by H. A. Foy for Philadelphia.**

## Reports on High-Strength Constructional Steels

Speaker: John Sands
***International Nickel Co., Inc.***

The speaker at a recent meeting of the **Penn State Chapter** was John Sands of the International Nickel Co., Inc. His talk was entitled "High-Strength Alloy Constructional Steels".

The specifications of constructional steels, especially with regard to strength, are continuously being raised by the aircraft industry. Nickel-chromium-molybdenum steels, with tensile strengths up to 200,000 psi., have been used for many years as constructional steels in aircraft. However, rising specifications have made these steels, with their "low" tensile strengths, inadequate for some applications. The heat treatments which were specified for these steels, which prohibited tempering below 800° F., limited their strength to 200,000 psi. Therefore, the first steps which were taken to develop higher tensile strength included a reduction in tempering temperature.

One of the early difficulties introduced by this step involved the "500° F. impact trough". Most alloy steels, when tempered around 500° F., suffer a drop in impact strength. Investigators found that additions of silicon on the order of 1 to 2% displaced this trough to higher temperatures, thus allowing higher tempering temperatures to be used which aided in relieving quenching stresses. It was also found that silicon increased the yield strength.

A second method of attack involved modifying the composition of the original 4340 steel. The carbon content was lowered, the molybdenum content was increased, and small amounts of vanadium were added. These changes did not displace the impact trough temperature-wise, but they did increase impact strength to a satisfactory level. By these two means tensile strengths up to 240,000 psi. were obtained.

But then the aircraft industry raised its tensile strength requirements again. Researchers investigated the properties of higher carbon variants, including 4340 itself with a revised heat treatment, and thereby developed alloy steels with tensile strengths up to about 300,000 psi.

Mr. Sands concluded his speech by noting some of the difficulties which have developed in the search for higher strength. Hydrogen embrittlement, in particular, has been quite troublesome. The effects of hydrogen are delayed, and failure will occur, in a brittle fashion in steels, under static loads considerably below the yield strength of the steel.

Mr. Sands believes that the future is bright for steels with tensile strengths of 300,000 psi., but consumers are still not satisfied, even now they are requesting steels of still higher strengths.—**Reported by D. A. Toland for Penn State.**

## Oak Ridge Features Talk on Artistry and the Engineer

At the annual ladies night meeting held by the **Oak Ridge Chapter,** C. Kermit Ewing, of the University of Tennessee's fine arts department, presented a short talk on "Artistry and the Engineer", in which he stressed the inter-relationship of the artist and the engineer and the growing recognition of the importance of each to the other.

New officers were also installed at this meeting.—**Reported by A. Goldman for Oak Ridge.**

## Compliments

To DONALD L. COLWELL, director of laboratories, Apex Smelting Co., R. E. PENROD, retired, chief metallurgist, Bethlehem Steel Co., and FRANCIS G. TATNALL, vice-president and general manager, Tatnall Measuring Systems Co., on receiving Awards of Merit from the American Society for Testing Materials for outstanding services rendered to the Society. Mr. Colwell is a past chairman of the Chicago Chapter A.S.M., Mr. Penrod, a member of Pittsburgh Chapter, and Mr. Tatnall, a past chairman of the Philadelphia Chapter, A.S.M.

♦ ♦ ♦

To GEORGE SACHS, professor of metallurgical engineering and associate director, Syracuse University Research Institute, on being awarded the Gaussmedal by the Academy of Technical Sciences in West Germany, for his achievements in the development of the general and applied science of metals, mechanical metallurgy and technology of structural materials. Dr. Sachs also received the Heyn Medal, the highest award of the Gesellschaft fuer Metallkunde, the German Society of Metals, for his contributions to the introduction of X-ray as a scientific tool and his analyses of steel hardening, precipitations and cold work. Dr. Sachs received A.S.M.'s Gold Medal in 1953. A graduate of Berlin Engineering School, he came to this country in 1936 after five years as director of metals research for Metallgesellschaft, Frankfort, Germany.

♦ ♦ ♦

To SHADBURN MARSHALL, on his appointment as director of metallurgical research at Air Reduction Co.'s Research Laboratories in Murray Hill.

♦ ♦ ♦

To JOHN F. BLACK, manager of sales, Steel Mill Division, Selas Corp. of America, on the very fine personal sketch appearing in the company's heat and fluid processing digest *High Gradient*.

♦ ♦ ♦

To ARTHUR L. LAMASTERS, formerly vice-president of Alloy Engineering & Casting Co., who has joined Michigan Industries Co. as vice-president with functional responsibilities for sales of their five divisions. Mr. LaMasters has been an A.S.M. member for 20 years and is presently chairman of the Peoria Chapter.

♦ ♦ ♦

To ALLISON BUTTS, professor of metallurgy at Lehigh University, who has been teaching there for the past 41 years, who was honored at the tenth annual faculty dinner in May. Prof. Butts, who retired on June 30, was presented with a silver tray with the inscription "Allison Butts, for loyal service to Lehigh University, 1916-1957".

## Lectures on Springs at Meeting in Rockford

### Speaker: R. R. Tatnall

*Wickwire Spencer Steel Co.*

"Springs" was the topic of the lecture presented before the **Rockford Chapter** by Rodman R. Tatnall of Wickwire Spencer Steel Co.

Mr. Tatnall discussed Hooke's Law and pointed out that this is of prime importance in designing springs. Also of great importance is the endurance limit, which is lower than the elastic limit. Therefore, using the endurance limit results in weight savings.

Various types of springs and their formulas were shown, and it was noted that steel is the most efficient material for work done per dollar.

In the manufacture of wire for springs, the analysis, heat treatment and amount of reduction of area are used to meet the customer's specifications. A tabular list of the minimum tensile strengths of the various grades of wire was shown.

Mr. Tatnall stated that the factors which affect failure are (a) design of spring, (b) manufacture of spring, (c) design of mechanism, and (d) metallurgy.—**Reported by Joseph F. Sisti for Rockford.**

### OBITUARIES

CLYDE G. ATCHINSON, assistant works metallurgist for Sheffield Division of Armco Steel Corp., passed away late in April. Mr. Atchinson became a member of the Kansas City Chapter in 1945 and was chairman for the years 1946-1947, publicity chairman from 1949 to 1950 and served on the executive committee from 1953 through 1955.

♦ ♦ ♦

CLARENCE A. LINSLEY, sales consultant in the Indianapolis, Ind., sales branch of Crucible Steel Co. of America, died on May 8. Mr. Linsley joined Crucible in 1923 and has served as manager of the St. Louis sales office and subsequently as manager of the Indianapolis branch office.

## Awarded A.S.M. Scholarship at Phoenix

*John Francis Peck (Left), University of Arizona Junior Majoring in Metallurgical Engineering, Is Shown Receiving a Plaque in Recognition of His Winning a National A.S.M. Scholarship. W. E. Taylor, chairman of the Phoenix Chapter, made the presentation during a recent meeting*

### Speaker: D. J. Murphy

*University of Arizona*

A special meeting of **Phoenix Chapter** was held in the Student Union Building at the University of Arizona. Official business for the meeting was the announcement and the awarding of a National A.S.M. Scholarship and plaque to John Francis Peck, who was selected by the faculty of the University of Arizona metallurgy department on the basis of scholarly achievement. The plaque was presented to John by William E. Taylor, chairman of the Phoenix Chapter.

Technical speaker for the evening was D. J. Murphy, professor of metallurgy, the University of Arizona, who discussed the problems and techniques which have been developed for microscopic examination of radioactive metallurgical specimens. Hot metallography requires the enclosure of the specimen within thick walls of cement or steel during preparation and examination so that human operators are protected from damaging radiation. This requirement has led to the development of elaborate hot cells which are equipped to carry out the necessary steps of cutting, grinding, polishing, etching and drying by remote manipulation.

# *Charter Presented at Delaware Valley*

*A. O. Schaefer, Past President A.S.M., and President, Pencoyd Steel & Forge Corp., Is Shown Presenting the Charter of the Delaware Valley Chapter to Howard Pietsch (Center) and Howard Godfrey (Right) During the Organizational Meeting Held by the Chapter Recently. Mr. Schaefer also presented a talk on "New Developments in the Forging Industry"*

Speaker: A. O. Schaefer

*Pencoyd Steel & Forge Corp.*

Some 280 metals men, including most of the 125 members and sustaining members, were present at the organizational meeting of the **Delaware Valley Chapter,** during which Past President A. O. Schaefer, president, Pencoyd Steel & Forge Corp., presented the Chapter Charter to Howard Godfrey, J. A. Roebling & Sons, and Howard Pietsch, U. S. Steel Corp., Fairless Works, who were responsible for the formation of the chapter.

Mr. Schaefer presented the technical address, discussing "New Developments in the Forging Industry". He reviewed the techniques of forging various materials and discussed heating furnaces and forging presses at some length. European practices in vacuum pouring were mentioned, as was the increased use of the vacuum pouring technique in America.

The dual problem of hydrogen and internal ruptures was considered, and Mr. Schaefer pointed out that the best-known ways to eliminate these problems are to vacuum pour and to control the heat treating cycle, especially where heavy sections are being cast. He suggested that diffusion of hydrogen does not seem to follow the normal law for explaining diffusion and, therefore, extra time and care are necessary to remove hydrogen from heavier sections when vacuum casting techniques are not used. He further suggested that hydrogen is an unusually obnoxious item in the field of very heavy forgings and that vacuum casting techniques are economical for many products despite the initial high cost of the equipment.—**Reported by Richard G. Storm for Delaware Valley.**

## Outlines Uses of Steel Castings at Chattanooga

Speaker: C. W. Briggs

*Steel Founders' Society of America*

The **Chattanooga Chapter** featured a talk on "Steel Castings, Their Application in Engineering Structures" by C. W. Briggs, technical and research director, Steel Founders' Society of America, at a recently held meeting.

Steel castings are made from all classes of steel with all ranges of properties. The carbon content usually ranges from 0.2 to 0.4%, but can be outside this range. Tensile strength of from 60,000 to 225,000 psi. can be obtained with hardness upward of 400 to 500 Brinell. Except for smoothing or spot finishing, castings are ready to use as produced. The structure is the same throughout with no directional grain arrangement or flow lines. Castings of from a few ounces to several tons are made.

With this summary of the properties and facts about castings, Dr. Briggs then showed examples of how castings can often replace welded, machined or forged structures or combinations of these. The result is often a lighter, stronger structure with streamlined curves instead of angles where cracks can originate, and the result is often cheaper. Dr. Briggs defined castings as the shortest path between design and finished part and urged designers to constantly strive to improve structure quality by improving design, keeping in mind the possibility that a casting might be the solution to this improved design.

He showed 60 slides as examples of: (a) Redesigning of castings to produce higher quality or lower cost castings; (b) redesign of cast iron to steel castings; (c) replacement of forgings by using steel castings; (d) redesign of weldments to steel castings; (e) use of cast-weld construction; and (f) the application of composite fabrication. — **Reported by J. H. McMinn for Chattanooga.**

# *Long Island Hears Talk on PH Steels*

*W. W. Rogers, Chairman, G. E. Linnert, Speaker, and S. L. Messina, Technical Chairman, Chat After Mr. Linnert's Talk on "Welding Precipitation-Hardening Stainless Steels" at a Meeting of Long Island Chapter. Mr. Linnert reviewed the fundamental types of precipitation hardening steels which are presently being used, and narrowed down the welding problem to the fundamentals involved, such as microstructure and other factors. He presented information on the mechanical properties which can be obtained by following recommended welding procedures for the precipitation hardening varieties of steels. (Reported by R. H. Witt for Long Island)*

## Speaks in Chattanooga On Oxidation of Metals

**Speaker: J. T. Waber**
***Los Alamos Scientific Laboratory***

Members of the **Chattanooga Chapter** heard J. T. Waber of the Los Alamos Scientific Laboratory talk on "Oxidation of Metals". Using the simile of an electrolytic cell, Dr. Waber showed the basic theory of metal oxidation as set forth in the Wagner theory which says that the metal-oxide film-gas atmosphere system may be thought of as an electrolytic cell in which the scale (the cell) has a metal-base cathode and a gas-atmosphere anode short-circuited by an external resistance (analogous to electron conduction through the oxide).

The scale which forms on oxidation is porous and allows diffusion of metal ions to the atmosphere and of oxygen and hydrogen into the metal base. Where we have sub-scale oxidation, the oxygen has diffused through the scale while other scales are built up in layers by diffusion of the metal to the surface.

Dr. Waber pointed out that hydrogen embrittlement, in which fish-eyes or blisters form in steel with resulting porosity, is an example of the diffusion of hydrogen into steel in which atomic hydrogen becomes molecular and creates high pressures. Using slides and answering questions from the floor, Dr. Waber showed examples of metal oxidation which could be explained by this theory.—**Reported by J. H. McMinn for Chattanooga.**

## *Explains Value of Vacuum Melting*


*F. N. Darmara (Left), Utica Drop Forge Division, Kelsey Hayes Co., Asked the Question "Does Vacuum Melting Earn Its Keep?" at a Meeting of the Washington Chapter. He is shown with Nathaniel K. Fick, chairman*

**Speaker: F. N. Darmara**
***Utical Drop Forge Division***

We are going to spend the next ten years taking the impurities out of our alloys, F. N. Darmara of Utica Drop Forge Division, Kelsey Hayes Co., told members of the **Washington Chapter.** Then, we will spend the next ten years after that putting them back.

Dr. Darmara spoke on the question, "Does Vacuum Melting Earn Its Keep?" His answer was that the new technology of melting high-quality alloys under high-vacuum conditions is expanding with explosive speed. Although the product should be practically restricted to meeting requirements for very high-quality, high-performance materials, capacity at the present time is lagging behind demand. For quality requirements, vacuum melting is definitely worthwhile from an economic standpoint.

Turning to the question of what level of quality, the speaker said that we are now melting closer than we can analyze chemically. He challenged the chemical industry's research people to "catch up with the metallurgists". Vacuum melting technology is now capable of controlling such important minor ingredients as boron to plus or minus five parts per million.

Dr. Darmara enlarged on the importance of these minor ingredients of quality alloys by showing the effect of boron, in parts per million, as one parameter against ductility of the alloy. The effect of boron is twofold—as an alloying additive and as a scavenger. In the latter function, a few parts per million of element X or element X-Y-Z are responsible for loss of ductility and by tying up such an impurity with a few ppm. of boron, its effect is diminished. The deleterious impurity might be lead, arsenic or bismuth, or perhaps calcium or tin.

In conclusion the speaker discussed some of the implications of the fact that the science of metallurgy, through the use of vacuum melting techniques, is now able to control the melting process with laboratory precision. He forecast "tenfold" improvement in alloy performance, with eventual reductions in cost of the process. One source of cost reduction, he believed, would be a progressive increase in the size of individual heats.—**Reported by F. P. Huddle for Washington.**

## *Describes Advances in Brass Industry*

*Wallaceburg Brass Ltd. Was Host to Members of the Western Ontario Chapter at a Recent Meeting. J. A. Burgess, vice-president, spoke on "New Processes in the Brass Industry". He explained shell molding and brass forging, and showed a moving picture to illustrate his talk. Shown are, from left: Mr. Burgess; Ray Cyr, vice-chairman; Lloyd French, Union Gas Co.; and Frank Miller, past chairman. (Reported by Frank Miller)*

# *Explains Impact Extrusion of Aluminum*

*A. M. Miller, Aluminum Co. of America, Discussed "Aluminum" at a Recent Meeting Held in Springfield. Shown are, from left: Bernard Mullen, Alcoa; Mr. Miller; Donald Barber, chairman; and F. Looney, vice-chairman*

Speaker: A. M. Miller
***Aluminum Co. of America***

Members of the **Springfield Chapter** viewed a very interesting movie entitled "Unfinished Rainbows" which depicted in technicolor the story of how aluminum became as prominent a metal as it is today. Its progress is due primarily to the efforts of Charles Martin Hall, who discovered a method of obtaining pure aluminum by passing an electric current through alumina dissolved in molten cryolite in a carbon crucible. His secret for smelting aluminum is basically the same as used today.

A. M. Miller, Aluminum Co. of America, discussed "Aluminum" by first giving an outline of the basic metallurgy of aluminum and its alloys. He chose from the wide field of aluminum the more interesting phase, called impact extrusion of aluminum. This method of forming aluminum has been used in this country for some 35 years. Some of the advantages of this process are:

1. Design flexibility—multiple parts can be combined into a single Alcoa impact eliminating welding and mechanical joint assemblies.
2. Alloy versatility—impacts are produced in a range of wrought aluminum alloys from common strain hardened to highest strength heat treatable alloys.
3. Close tolerance—available through inherent accuracy of the process by permitting the design of draft free close tolerance parts requiring minimum machining.
4. Smooth surface—since impact extrusion parts have no parting line, the smooth bright surface rarely needs finishing and can be lithographed or can be colored by Alcoa's Alumilite process.
5. Economy—the part is produced in one operation with relatively low tool costs and high production rates.
6. Strength—the parts are sound and fully wrought and have very desirable grain flow characteristics.

Impact extrusion is done at room temperature and three basic toolings are involved—reverse extrusion, forward extrusion and simultaneous forward and reverse extrusion. Some of the applications for this process are in the automotive field for hydraulic brake pistons, baffle tubes on shock absorbers, reservoirs for power brakes, oil filters and spark plug covers. Some of the more commonly used household applications are flashlight cases, vacuum bottle tubes and door check cylinders.

Mr. Miller brought with him many samples of impact extruded parts to illustrate his talk and after the formal meeting he answered many specific questions involving this interesting process.—**Reported by L. E. Celender for Springfield.**

## Progress in Titanium Research Is Subject of Burgess Memorial Lecture

Speaker: Matthew A. Hunter
***Rensselaer Polytechnic Institute***

The Burgess Memorial Lecture of the **Washington Chapter,** entitled "Progress in Titanium Research", was delivered by Matthew A. Hunter, dean emeritus of Rensselaer Polytechnic Institute.

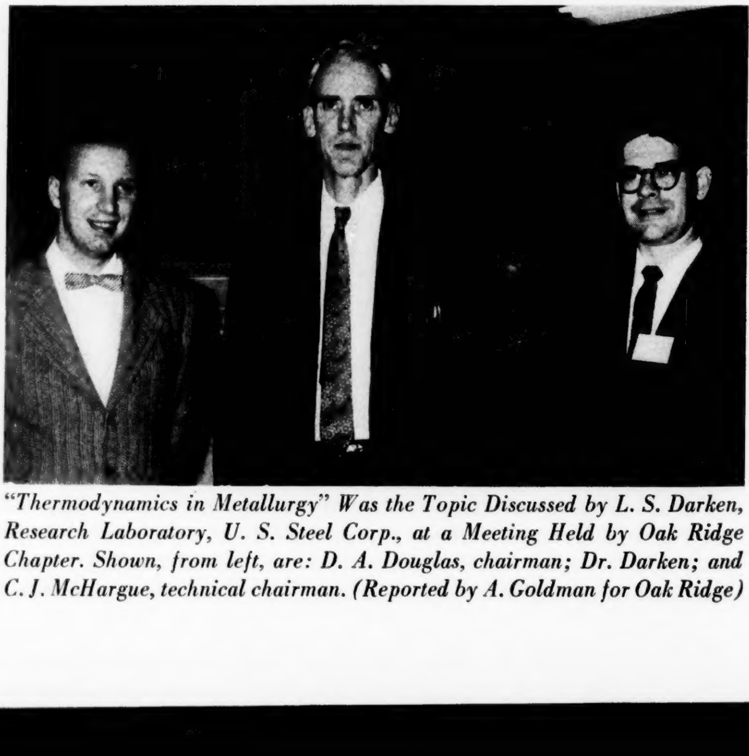
Dr. Hunter noted that the initial impetus given to titanium research was the misapprehension that titanium had an extremely high melting point. He noted that titanium has enjoyed rapid growth, largely under military sponsorship, with probably less than 10% of the product being consumed in nonmilitary uses. He foresaw a capacity by late 1957 of 36,500 tons annually.

An important metallurgical question in titanium is the development of better and less costly methods of production.

It is Dr. Hunter's contention that the sodium reduction process had not been fully exploited and that it has potentialities for cost reduction. He also sees long-range opportunity of great importance in electrolytic refining methods and urges that the electrothermal reduction of titanium oxide and the electrolytic refining of the resultant alloy at the stations of the Bureau of Mines should be adequately supported and that the experimental work he pushed as rapidly as possible.

A question period followed Dr. Hunter's informative talk.—**Reported by F. P. Huddle for Washington Chapter.**

# *Thermodynamics Topic at Oak Ridge*



*"Thermodynamics in Metallurgy" Was the Topic Discussed by L. S. Darken, Research Laboratory, U. S. Steel Corp., at a Meeting Held by Oak Ridge Chapter. Shown, from left, are: D. A. Douglas, chairman; Dr. Darken; and C. J. McHargue, technical chairman. (Reported by A. Goldman for Oak Ridge)*

# Problems of High-Speed Flight Given At Santa Clara

**Speaker: S. B. Batdorf**
*Lockheed Aircraft Corp.*

At a recent meeting of the **Santa Clara Valley Chapter,** Samuel B. Batdorf, director of Weapon System "A", Technical Division, Lockheed Aircraft Corp., spoke on "Structural Problems in Hypersonic Flight".

In retrospect the structural problems of subsonic flight exhibit an engaging tractability. The laws of elasticity provided a reliable guide to the approximate behavior of proposed structures and satisfactory materials were available. Designers with experience and skill could practice their art with a measure of confidence.

Under the flight conditions and high speeds made possible by modern means of propulsion, the situation is entirely different. The underlying cause of most of the difficulties involved is aerodynamic heating.

When air flows at high speed over the surface of an airplane or missile in flight, the air close to the surface is heated by adiabatic compression, by viscous energy dissipation, or both. Heating rates vary with altitude and Mach number. There are limits to the speeds that can be tolerated, and the allowable speeds are higher at higher altitudes. There is also a lower limit to the speed at which an aircraft can maintain steady flight at constant altitude. As a result, there exists what is called a corridor of continuous flight. Analysis shows that if skin temperatures considerably in excess of 1500° F. can be tolerated, there is no structural obstacle to the attainment of arbitrarily high flight speeds, provided the altitude is appropriately chosen. If such skin temperatures cannot be tolerated, then an upper limit to flight speed exists.

Variation in temperature through the aircraft structure gives rise to stress. The stress depends upon the temperature distribution throughout the structure and this, of course, varies continually and rather rapidly as the heat flows from the skin into the interior. Consequently the stress distribution changes with time also.

Thermal stresses are characteristic of the early stages of rapid heating and tend to be alleviated as the temperature becomes uniformly distributed. However, two other difficulties then become serious: the onset of creep and the loss of structural strength. In practice both the stress level and the temperature vary with time and a functional relation expressing the interdependence of these quantities is needed for purposes of analysis. Generally valid stress-strain-time-temperature relations do not exist for structural materials at present, so that accurate prediction of structures under variable loading conditions at high temperatures is in principle impossible.

Dr. Batdorf compared the stress-rupture properties of the promising materials for elevated-temperature use. The loss of strength at high temperature is characteristic of alloys and the difficulty associated with attempts to use the more refractory metals has turned attention to the ceramics. However, they are generally too brittle for use as structural parts in aircraft or missiles.

The aerodynamicist would like to have a rigid structure. The stiffness per unit weight of structural material, or Young's modulus divided by density, is a measure of the structural efficiency of tension members when stiffness at low weight is the governing consideration. Most materials of structural interest have practically the same value for this ratio. The requirement of no buckling, however, places a premium on low-density materials.

A notable exception to the rule that Young's modulus is proportional to density is provided by beryllium, which has about six times as high a ratio of Young's modulus to density as magnesium, aluminum, titanium or iron. Its merits as an aircraft structural material are indeed impressive. The principal disadvantages are cost, inherent scarcity, toxicity and brittleness.

Dr. Batdorf remarked that it is apparent that high-speed flight presents a major structural challenge. It is necessary to consider for airframe use materials that were once of concern only to engine manufacturers, and even they are not good enough. The theory of elasticity, such a valuable aid in low-speed flight, loses its validity in high-speed flight due to the effects of high temperature on the materials, but there is as yet no satisfactory substitute. Instead of a stress-strain relation, a stress-strain-time-temperature relation is required.—**Reported by C. O. Matthews for Santa Clara Valley.**

# *Savannah River Sponsors Course*


*Shown Talking With F. N. Rhines (Right), Carnegie Institute of Technology, Who Presented the First of a Series of Lectures on "Engineering Metals" Sponsored by Savannah River Are, From Left: G. W. Beckman, E. C. Laing, C. C. McBride, W. L. Worth and P. E. England. (Photo by A. Thomas)*

A series of weekly lectures on the subject "Engineering Metals" was presented by the **Savannah River Chapter** in North Augusta, S.C., recently. Six lectures were given on the structure and properties of metals, and on the processes by which desirable properties are obtained in the important engineering alloys. The speakers and their topics were as follows: Fundamentals of Metallurgy, by F. N. Rhines, Carnegie Institute of Technology; Steel, by C. C. McBride, Savannah River Laboratory; Cast Iron, by G. W. Beckman, Savannah River Laboratory; Stainless Steel, by M. L. Holzworth, Savannah River Laboratory; Light Metals, by W. L. Worth, Savannah River Plant; and Metals of Atomic Energy, by B. W. Dunnington, Savannah River Laboratory.

The first lecture, by Prof. Rhines, covered the fundamental ideas needed to understand the structure and properties of metals. The remaining lectures covered specific engineering metals, giving details of their behavior. The last lecture centered around uranium and zirconium, new and unusual metals which have become important in the atomic energy industries.—**Reported by W. R. McDonell for Savannah River.**

**A.S.M. spends $44.50 to service each member of the Society for a period of one year.**

# *Gives Practical Aspects of Quenching*

*Members of the Indianapolis Chapter Heard K. F. Schauwecker, U. S. Steel Corp., Speak on the "Practical Aspects of Quenching". At the speakers' table were, from left: George J. Shubat, vice-chairman; G. Gladhill, sales manager, U. S. Steel Corp.; Mr. Schauwecker; and E. Tuttle, chairman*

Speaker: K. F. Schauwecker
*U. S. Steel Corp.*

The technical speaker at a recent meeting of the **Indianapolis Chapter** was Karl F. Schauwecker, service metallurgist, U. S. Steel Corp., who spoke on "Practical Aspects of Quenching".

The ancient art of heat treating evolved from man's discovery that steel can exist in a wide variety of conditions, ranging from quite soft to remarkably hard, and that it can be changed by heat treatment. Through the ages man gradually developed heat treating as an art but the understanding of the fundamental principles governing the microstructural changes is of recent origin.

Microstructures all result from the transformation of austenite. Transformation at a temperature between 1300 and 1000° F. gives lamellar pearlite; transformation at a temperature from 1000 to 650° F. gives bainite; transformation below 650° F. gives martensite.

The most common method of hardening steel by heat treatment consists of heating to a temperature at which the steel becomes austenitic and then cooling fast enough, usually by quenching in a liquid such as water or oil, to avoid any transformation of the austenite until it reaches the relatively low-temperature range within which it transforms to the hard martensitic structure. The minimum rate of cooling necessary to accomplish this is set by the minimum time required for the beginning of transformation at the "nose" of the curve.

The basic object of quenching is to prevent the transformation of austenite in the steel until its temperature is relatively low.

According to the generally accepted theory of the mechanism of heat transfer in quenching without agitation of the bath or the steel, the rate of cooling inside a piece being quenched is determined chiefly by the surface cooling rate, which exhibits the following three stages:

1. Vapor blanket stage—The temperature of the piece is high and going into the quench medium vaporizes it so that a thin stable film surrounds it. The cooling rate for this stage is slow.
2. Vapor transport stage—The piece cools so that no vapor film is formed and the quenching medium wets its surface and boiling ensues. The cooling rate for this stage is rapid.
3. Liquid cooling stage—The surface temperature of the piece approaches the boiling point of the quenching medium. The cooling rate for this stage is slow.

The temperature transition from the slow first stage to the rapid second stage and the time required to enter the second stage can be shortened by motion of the part being quenched or by agitation of the quenching media.

In the days when quenching operations were carried out by hand, there must have been a realization of the good of agitation because it was a quite common practice to move the piece about in the quench liquid. Today, in large operations, in order to provide the same heat transfer situation it is necessary to force the quenching medium surrounding the part into a continuously turbulent motion.

This turbulence of the quenching medium is provided by pumps that move the medium into the quench tank from a cooler and through the tank, which is gentle agitation, and propellers with submerged jets and high capacity pumps, which is violent turbulence.

The turbulence must be uniform to avoid nonuniform cooling. Parts should be in the region of uniform turbulence and not directly in front of the propellers or jets.

Benefits to be gained from violent uniform turbulence of the quenching media include reduction or elimination of warpage and cracking, improved mechanical properties, and economies from a shortened heat treating cycle.

In good quenching practices the cooling rate should be rapid enough to prevent high-temperature transformation, thus preventing soft spots, low yield strengths and, sometimes, poor machinability. Agitation of the liquid quench medium against the hot workpiece accelerates quenching, especially during the vapor transport stage of cooling. Proper agitation keeps the temperature of the quenching liquid more uniform and thus increases the efficiency of the quench. Proper agitation also keeps the surface temperature of the workpiece uniform during the final stage of quenching which tends to equalize strains that would otherwise cause distortion.—**Reported by Dorothy Holbrook for Indianapolis.**

## Extend Invitation to All Members for Metals Slogan

The American Society for Metals extends an invitation to its members to submit slogans to further the general awareness of the American public in the field of metallurgy. The letter following was sent to A. O. Schaefer, past president A.S.M., now president, Pencoyd Steel & Forge Corp., by Horace C. Knerr, president, Metlab Co.

"At one time you mentioned that the chemical industry (DuPont) had made quite a slogan of 'Better Life Through Chemistry' and that you thought it would be a fine thing for A.S.M. to adopt a similar slogan to promote metallurgy.

"In this connection, I would like to offer the following for the consideration of yourself and your associates.

SECURITY AND PROGRESS
THROUGH METALLURGY

"It hardly seems necessary to comment that everyone is interested in his own security, to make a living, to do a better job in his production whatever it may be and to assure security for our Country.

"Also, nearly everyone is interested in 'progress' which makes for a better life, more economy, more production, more conveniences, etc.

"Therefore, this slogan might catch on."

Members should submit slogans along with brief explanations of their reasons for thinking that such slogans are representative of the field of metallurgy and the metals industry. Send them to: Box S, Metals Review, 7301 Euclid Ave., Cleveland 3, Ohio.

# *Ontario Holds Ladies Night Dinner Meeting*

*Shown at the Annual Ladies Night Meeting Held by Ontario Chapter at the King Edward Hotel in Toronto Are Most of the 686 Persons Who Attended the Banquet and Dance. P. E. Cavanagh and H. G. Warrington were chairmen of the Chapter's extremely successful social event. (Reported by V. G. Behal for the Ontario Chapter)*

## Puget Sound Increases Educational Benefits

A letter directed to Henry Schmitz, president, University of Washington, from Howard L. Southworth, secretary-treasurer of the **Puget Sound Chapter,** is an example of how one chapter supports a worth-while educational program.

"At the Apr. 22 meeting of the executive board of the Puget Sound Chapter of the American Society for Metals, several motions were passed which will permit further educational activities of the Chapter this year. As you may recall, on Jan. 5, 1957, we were able to present the sum of $100 to the Division of Metallurgical Engineering for use in research at both the undergraduate and graduate levels.

"I am very happy to report to you now the decisions made which are of direct interest to the University.

1. To again provide a $200 scholarship for an outstanding sophomore student in metallurgy.

2. To add $200 to the previous $100 given for a Metallurgical Research Fund. It was further agreed that the purpose of this fund be extended to aid in payment of personal expenses of members of the staff of the Division of Metallurgical Engineering incurred by their attendance at metallurgical conferences or conventions. Personal expenses were defined as those other than transportation costs to and from such meetings.

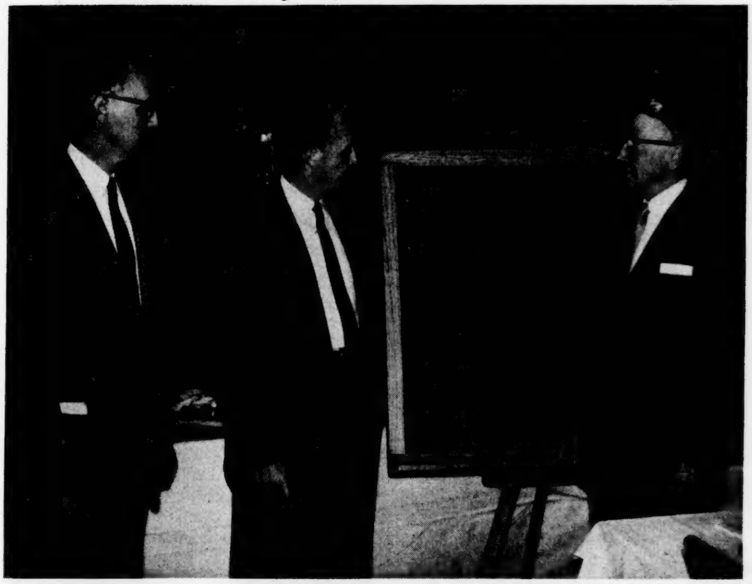
3. A dinner meeting is to be held at which the freshmen students indicating an interest in metallurgy and the student officers of the University Chapter of A.S.M. will be the guests of the executive board of the Puget Sound Chapter. The purpose of this meeting is to present an opportunity for these students to talk with men actively engaged in industrial metallurgical pursuits.

4. Two thousand copies of a brochure published by the American Society for Metals, 'Metallurgists Needed Badly', are being procured for eventual distribution to prospective students of the University.

"These actions, involving apportionment of approximately $600 for the year, have been made possible by a growing membership and the energetic participation of a group of officers and members who have given much time to bring about our very successful past season. The Chapter is very gratified that their efforts have made the expenditure of these funds possible.

"Details of the awarding of the scholarship and disbursements from the Metallurgical Research Fund are known to E. C. Roberts of the Division of Metallurgical Engineering. A check for $400 is being forwarded to the Division by copy of this letter."

# *Gives History of Induction Heating*



*"Latest Developments in Induction Heating" Were Described by Harry B. Osborn, Jr., Technical Director, Tocco Division, Ohio Crankshaft Co., at a Meeting Held by the New Haven Chapter. Pictured are, from left: J. D. Berwick, technical chariman; Dr. Osborn; and E. P. Holtberg, chapter chairman. (Reported by James L. Baker for New Haven Chapter)*

# *Details Guided Missiles Problems*

*Proudly Displaying Silver Certificates at a Meeting in Cleveland in Recognition of 25 Years of Continuous Membership Are W. K. Bock (Left), National Malleable and Steel Castings Co., and W. A. Dean, Aluminum Co. of America. The certificates were awarded during a meeting at which W. H. Steurer, Army Ballistic Missile Agency, spoke on "Guided Missiles"*

### Speaker: W. H. Steurer
***Army Ballistic Missile Agency***

"Guided Missiles, Their Development and Metallurgical Problems" were discussed at a recent meeting of the **Cleveland Chapter** by W. H. Steurer, head of material research, Army Ballistic Missile Agency. Having been chief of the material testing laboratory in the German Rocket Development Center at Pennemuende, Germany, where the V-2 rocket was developed, he was able to show the development steps from the fireworks-type rocket to today's missile, both in this country and Germany. The basic design remains primarily—the fuselage, the propulsion system, the guidance system and an optional payload, each with their components. Vital to research on these are three engineering groups: the aircraft engineers (the airframe); the chemical engineers (the propulsion system); and the electronic engineers (the guidance system).

The work of these groups cannot be done with limited funds or as a back-yard operation. Defense, regarding the rockets as potential weapons, pays the bill. The work is not glamorous as science fiction would have us believe but painstakingly long.

In describing the many problems, Dr. Steurer told of temperatures above the melting point of available metals in the nose cone and propulsion systems, low temperatures in areas such as the liquid oxygen container and the guidance compartment where temperature must be controlled.

Some high-temperature problems are handled by various cooling techniques and by design. Cooling, however, is difficult to accomplish in the structure; therefore the materials themselves are concentrated on. Certain metallurgical changes in these materials that would damage their usefulness may take more time than is required for them to work in the missile. Impurities often cause a lag in metallurgical changes, therefore they can be an aid. The age hardening and cold working effects on metals prove quite useful. Research on this basis shows that at short times, many materials can be used that would otherwise be useless. A series of tests under rapid heating and various periods of heat exposure produces the stability characteristic of a material, which permits selecting the strength for any time of operation.

A problem shown and explained was the surface heat problem involved in aerodynamic heating. Cermets have been used but the surface temperatures are too high even for them. Times are normally short so that the thermal problems of the skin can be handled on a material removal basis only. Comparing materials with high versus low conductivity, with the latter only the surface layer is removed and the whole thickness does not disintegrate rapidly. Using the thermal capacity of the metal, a thicker skin can be developed to survive the short time life of the missile.

Considering today's missiles, such as ICBM and IRBM, testing itself is a problem. It is extremely difficult to simulate flight conditions in the laboratory. In trying to interpolate as much as possible, more research is needed in each field to put together results to simulate actual flight.

Dr. Steurer showed the many types of missiles involved, such as the surface to surface, surface to air, air to surface, antimissile types and others.

With the ultimate goal of space travel in sight, the speaker predicted we should soon reach our neighboring planets. By the use of multistage missiles and by establishing satellites, the threshold of outer space will be reached. In space travel, finally, new conditions may exist which must be designed for. But although absolute zero will be encountered, vacuum, lack of night and day, unknown gases and rays, and others, all these problems will be less severe than those being solved today in penetrating the Earth's atmosphere. — **Reported by J. J. Glubish for Cleveland.**

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## Reports on Uses of Low Carbon Steels in Dayton

### Speaker: Robert H. Aborn
***U. S. Steel Corp.***

Robert H. Aborn, U. S. Steel Corp., presented a talk on "Heat Treatment and New Uses of Low Carbon Steels" at a meeting of the **Dayton Chapter.**

Metallurgists have always avoided nontempered martensite because of its brittleness. Its high strength is very attractive, but its susceptibility to cracking has prevented its use.

At the research laboratories of the U. S. Steel Corp., under the direction of Dr. Aborn, ductile martensite was formed in low carbon steels of less than 0.20% carbon. Instantaneous tempering occurred at approximately the same temperature as the martensite formation because of high $M_s$ temperatures due to low carbon content. To this unique form of tempering the name "Q-tempering" has been understandably assigned.

Dr. Aborn showed a high-speed motion picture, taken through a microscope, of the formation of slip bands caused by tensile stress applied at 75° F. to a polished and etched strip of austenitic stainless steel, Type 301. The cold work transformed the unstable austenite to low carbon martensite with characteristic high strength and toughness.

Many of the members took advantage of the informal refreshment period after the meeting to discuss these low carbon martensites with the speaker.—**Reported by R. A. Grayson for Dayton.**

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## Rockford's Heat Treating Course Has Large Attendance

**Rockford Chapter** has completed a five-session lecture series on "Heat Treating—Principles, Practices and Methods". The course, which was set up for about 75 to 80 people, drew 189 registrations, with an average attendance of over 150. A very considerable number of these registrants also attended the technical meeting at which H. B. Osborn, Jr., technical director of the Ohio Cranksaft Co., spoke, as guests of the Chapter.

# Meet Your Chapter Chairman

### COLUMBUS

FRANCIS W. BOULGER, chief of the Division of Ferrous Metallurgy at Battelle Memorial Institute, has been closely associated with much of the research center's work on machinability, cast steels, cold drawn steels, deoxidation, nonmetallic inclusions, special alloy steels and steel forgings.

During the past several years, Mr. Bougler has become an accepted authority on shaping of metals, particularly in metalcutting and machinability. His work on the constant-pressure lathe test for measuring the machinability of free-cutting steels has been particularly well received. He participated in early development work on leaded steels and in the creation of improved, sulphurized free-cutting steels.

*F. W. Boulger*

Mr. Boulger, a native of Minneapolis, holds a B.S. degree from the University of Minnesota and a M.S. degree from Ohio State University. He has been a member of the Battelle staff since 1938, prior to which time he was employed by the Republic Steel Corp. In 1936 he was a Battelle Fellow in metallurgy at Ohio State. He is a member and past chairman of the American Institute of Mining, Metallurgical and Petroleum Engineers' Committee on the physical chemistry of steelmaking, a member of the American Society of Mechanical Engineers' Committee on plastic working of steels, and a member of the American Society for Testing Materials' Committee A-1 on steel. In addition, he is a member of Sigma Xi, professional research honorary.

### PHILADELPHIA

WALTER J. KINDERMAN, director of research, Yarnall-Waring Co., is a graduate of the University of Pennsylvania. His first work after college was designing dies and machines and later heat treating furnaces and equipment. He holds a number of patents in this line.

Having six children no doubt motivated the interest and time Mr. Kinderman has spent in educational work. He speaks at career conferences held in Philadelphia public schools. As a member of the National Committee on Vocational Education he helped to establish the Metals Technology course for vocational and science teachers at the University of Pennsylvania, and also gave time to student promotion work interviewing applicants for admission. For many years he has instructed and lectured at Temple University Community College, and for a time was director of the evening metallurgy course. As a member of A.S.M.E. he was adviser to juniors as well as being secretary and chairman.

He is a member of A.S.M. Junior Advisory and Educational Committees, also the Textbook Committee with which he collaborated with other members in the writing of "Basic Metallurgy", a book published by A.S.M. in 1954.

# *Mairs Receives 1957 McFarland Award*

*Robert W. Lindsay (Left), Department of Metallurgy, The Pennsylvania State University, Presents the David Ford McFarland Award Sponsored by Penn State Chapter to Elwood D. Mairs of the Aluminum Co. of America*

Elwood D. Mairs, Aluminum Co. of America, was presented the ninth David Ford McFarland Award for his achievements in metallurgy by the Penn State Chapter A.S.M., which chooses recipients from the metallurgical alumni of The Pennsylvania State University.

The award is named for and is in honor of the late David Ford McFarland, for 25 years head of the metallurgy department at Penn State, and an outstanding teacher.

Mr. Mairs has been employed by the Aluminum Co. of America since his graduation from Penn State. Starting at New Kensington, he was soon transferred to Massena, N.Y., where he became assistant works manager in 1945. In 1949 he organized the company's fabricating division in Vancouver, Wash.. and in 1956 he was transferred to Lafayette, Ind., where he took over as works manager of Alcoa's largest extrusion and tube mill.

Mr. Mairs delivered an address on the "Growth of the Aluminum Industry" at the technical session during which the award was made. He traced the history of the aluminum industry in America from its inception to the present. Along the way he found opportunity to describe incidents and milestones which could be recognized and properly evaluated only by someone with his knowledge of the industry. He described those properties of aluminum which make it a particularly useful metal and which have led to the enormous expansion in its use. He concluded with a description of the modern equipment at Alcoa's plant in Lafayette. Some of the machinery is of extraordinary size and makes possible the fabrication of aircraft parts of large dimensions. The use of such parts has led to many improvements in aircraft while at the same time lowering the cost of aircraft construction.

The presentation ceremonies were presided over by Robert W. Lindsay of Penn State's department of metallurgy. Prior to the presentation of the award, members of the Penn State Chapter and their guests were greeted by Eric A. Walker, president of the University, M. E. Bell, assistant dean of the College of Mineral Industries, and Amos J. Shaler, head of the department of metallurgy. Among the guests were several of the preceding eight recipients of the award.

# Speak at Chicago-Western Seminar

*Those Responsible for the Great Success of the Recently Held Seminar on "Mechanisms of Deformation and Fracture" Held by Chicago-Western Chapter Included, From Left: M. Gensamer, Columbia University, Moderator; C. S. Barrett, University of Chicago, Host; and R. M. Brick, Continental Can Co., J. R. Low, General Electric Co., and G. V. Smith, Cornell University, Speakers. The Seminar was held at University of Chicago*

The second annual seminar sponsored by the **Chicago-Western Chapter** was held recently on the University of Chicago campus. Over 250 were in attendance for the one-day program on "Mechanisms of Deformation and Fracture".

After opening remarks by C. S. Barrett, Institute of Metals, University of Chicago, the session was turned over to M. Gensamer, Columbia University, who served as moderator.

R. M. Brick, Continental Can Co., opened the seminar with a discussion of "Creep and Strain Hardening at Low Temperatures". He pointed out that "cryogenic creep", relatively newly discovered by Cohen and Averbach at M.I.T., is a phenomenon of time-dependent flow which occurs at stresses just below the yield point of steel stressed at low temperatures. This creep is associated with the delay time for yielding at low temperatures and therefore is related to the normally observed great increase in yield strength of steels at low temperatures.

The second part of Mr. Brick's talk dealt with the definition of strain hardening. He argued that not only the slope of the flow part of the stress-strain curve is important but its stress level and therefore the strain hardening exponent is the best criterion. Its relationship to 500° F. temper embrittlement and to notch sensitivity of nonferrous alloys was brought out.

J. R. Low, General Electric Research Laboratory, spoke on "Dislocations and Brittle Fracture of Metals". He reviewed the various dislocation mechanisms which have been proposed for crack initiation and compared these with the experimental observation of brittle fracture stresses for metals. He concluded that the models thus far proposed are not too satisfactory for explaining the exact role of dislocations since all of these mechanisms would require the cooperative action of unreasonably large numbers of dislocations.

He presented experimental observations which indicate that inclusions, second phase particles, grain boundaries and small angle boundaries affect the nature of cleavage steps. An increased number of cleavage steps slows down the rate of crack propagation because of increased energy absorbed.

G. V. Smith, Cornell University, discussed "Deformation and Fracture at High Temperature". After a brief review of the nature of the creep flow process, he summarized some of the recent experimental observations in the field.

The interpretation of microscopic observations made on coarse-grained materials strained under creep conditions is extremely complex. Since the observations have been made on the surface, some doubt has been created as to the condition of the interior grains. Creep at high temperature is primarily associated with intergranular phenomena, whereas at low temperatures, transgranular deformations are important.

Grain boundaries are important in creep at higher temperatures since very few slip lines can be observed. Intergranular creep at elevated temperature is associated with cell formation or polygonization, as evidenced from the nature of Laue spots.

The process of creep, when measured over short-gage lengths in coarse grained material, is cyclic. Macroscopic creep may be divided into grain boundary sliding and migration, coarse intergranular creep which involves visible slip lines, and a large component of "missing" creep or fine slip. A model of lattice deformation was presented to explain both intergranular creep and grain boundary movement during creep in which both coarse and fine slip occur, leading to strain hardening followed by polygonization, which then permits the processes to repeat.

The activation energy for creep for a number of metals has been found to be the same as the activation energy for self-diffusion. This indicates that creep is a diffusion controlled process and may involve the migration of dislocations.

It was also pointed out that the causes of intergranular fracture associated with creep at high temperature are not clearly understood but are hypothesized to be associated with cracks formed at the grain boundaries by the relocation of shear stress, presence of impurities which prevent the transfer of shear across the grain boundaries and migration of vacancies to grain boundaries to form voids.

Dr. Gensamer concluded the seminar by summarizing some of the results of tensile tests carried out at low temperature. He pointed out that, although polycrystalline iron alloys usually have a 1 or 2% ductility at low temperature, a 3½% Ni alloy has recently been found to have approximately 30% reduction of area at low temperatures. A 50% increase in fracture stress on zinc single crystals can be obtained by coating. This difference can be explained on the basis of the different type of twins observed. Calculation indicates that the stress from a pile-up of dislocations is too small by a factor of ten to account for the observed strength.

Determination of the ferrite mean free path in bainite by electron microscopy as a function of hardness for various transformation temperatures does not agree with similar data obtained from pearlitic structures.

The speaker pointed out that engineers have a serious and difficult problem in designing for brittle behavior because the transition temperature varies as a function of section size; however, correlation can now be obtained between different types of tests.

Recent experiments with a wedge driven by a pellet blow into the crack of a tensile specimen have been used for determining the fracture stress. Results indicate that the transition temperature is about

*(Continued on p. 23)*

# Bearing Metallurgy Is Detroit Topic

*H. O. Walp, S.K.F. Industries, Spoke on "Metallurgy of Ball and Roller Bearings" at a Meeting Held by Detroit Chapter. Shown, from left, are: R. Chapman, chairman; Mr. Walp; and O. McMullan, technical chairman*

Speaker: H. O. Walp
*S.K.F. Industries*

The **Detroit Chapter** enjoyed an informative talk by H. O. Walp, chief metallurgist, S.K.F. Industries, on the "Metallurgy of Ball and Roller Bearings". Numerous slides were used to illustrate the talk.

The history of the bearing industry was traced to the present high stage of development as a billion dollar a year business.

The two most common types of bearing steels are the high carbon-chromium deep hardening grades, of which 52100 is the best example, and the carburizing grades, such as 8620, 4620, 4720, 3320, 4320 and Krupp. Special applications, such as those requiring high hot hardness, employ bearings made from high-speed steel.

Quality requirements for bearings are very stringent and place special restrictions on quality of the steel and in manufacturing practices. Cleanliness of the steel is more critical for balls than the races.

Principal causes for failures are fatigue, improper design, abuse, inadequate or improper lubrication, false brinelling, electrical pitting, corrosion, wear from abrasive dirt, and various material and manufacturing defects.

Fatigue failures are the ultimate end of all bearings if it were possible to run them long enough. Failures of this type can result from inclusions beneath the surface, distortion of the crystal lattice, breakdown of martensite to a dark constituent, and trace elements, which are a possible cause.

Failures cannot always be attributed to dirty steel. Some heats classified as dirty with nonmetallic inclusions have resulted in longer life than heats which were much cleaner.

A properly heat treated structure is of prime importance to good bearing life. Bearings with structures containing undissolved pearlite will result in only about 1/10 the life of those having a good structural condition. Grinding of bearings must be carefully controlled so as to avoid localized heating which can result in severe cracking.

Dimensional stability can be achieved by the proper combination of temperature and time. Cold treating is of advantage in small parts but is hazardous on large or complicated sections.

Magnaflux inspection can be a good tool when the results are properly interpreted. Small indications, which appear on the surface, are usually not harmful, because failures always originate in a zone below the surface. However, a large, open type indication would definitely be considered undesirable.

Vacuum melted steel for bearings has shown promise. Some heats have resulted in considerably higher endurance limits than electric furnace quality steel and some have shown no better performance. However, none of the vacuum melted steels have been worse than good electric furnace quality. More time and work will be required to make a proper evaluation of this situation. **—Reported by Walter H. Braun for the Detroit Chapter.**

*(Continued from p. 22)*

the same regardless of the method of measurement. Silicon, manganese and phosphorus seem to have little effect on this temperature, whereas there appears to be a good correlation with carbon content.

The term "calamity temperature" was used by Wells to describe the temperature where a given specimen will fail by fracture at stresses considerably lower than necessary at higher or lower temperatures. Calculations were presented for determining the work necessary for fracturing specific sized specimens.

The success of this seminar was due to the fine arrangements made by the Committee, headed by V. Pulsifer, Armour Research Foundation, to Paul Gordon, Illinois Institute of Technology, who arranged for the speakers, and to the excellent cooperation from the University of Chicago.—**Reported by Melvin H. Mueller for Chicago-Western.**

# Akron Chapter Greets New Chairman

*At the Annual Meeting Held Recently by the Akron Chapter, New Officers for the 1957-58 Season Were Announced. Shown above are outgoing chairman Arthur E. Marble (left) and incoming chairman Manual Goldman (right)*

## *Describes Secondary Hardening*

*A. E. Nehrenberg, Crucible Steel Co. of America, Presented a Talk on "Secondary Hardening in Hot Work and High Speed Steel" at a Meeting in Springfield. Shown are, from left: F. D. Looney, vice-chairman; E. M. Murphy, Crucible; Mr. Nehrenberg; and D. G. Barber, chairman*

### Speaker: A. E. Nehrenberg

***Crucible Steel Co. of America***

A. E. Nehrenberg, supervisor, research and development laboratory, Crucible Steel Co. of America, spoke before a record turnout of members of the **Springfield Chapter** on "Secondary Hardening in Hot Work and High Speed Steel".

Mr. Nehrenberg illustrated with slides the comparison of various types of steel, namely 0.75% carbon, which has a uniform rate of drop in hardening when tempered, and the 18-4-1 type high speed steel, as well as Crucible's ChroMow grade of hot work steel. The slides showed that by increasing the tempering temperature of high speed steel, as well as hot work steels, an increase in hardness or secondary hardening is noticed.

Mr. Nehrenberg further explained that there are four stages of tempering in carbon and low alloy steels.

1. Formation of epsilon carbide and 0.25% carbon martensite up to about 400° F.
2. Transformation of retained austenite from about 350 to 700° F.
3. Formation of cementite from epsilon carbide and 0.25% carbon martensite from about 400 to 800° F.
4. Formation of alloy carbides from cementite and alloy in tempered martensite at about 850° F.

Secondary hardening is definitely attributable to the precipitation of alloy carbides. This precipitation produces an increase in hardness in the same manner as in other age hardening reactions. Another interesting aspect of secondary hardening is the fact that the austenitizing temperature of high speed steel not only puts carbides in solution, but also puts the alloying elements, which contribute to age hardening, into solution. The types of carbides which cause secondary hardening in hot work and high speed steel are $Mo_2C$, $W_2C$, $(Mo,W)_2$ and VC. It is the effective combination of the aforementioned alloying elements which gives the best results in obtaining secondary hardening.

Mr. Nehrenberg distributed copies of an article which he wrote for *Steel Magazine* on master tempering curves, which described how such curves may be used to estimate the effect of long-time service at elevated temperatures on the hardness of quenched and tempered steels.—**Reported by L. E. Celender for Springfield Chapter.**

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## Awarded A.S.M. Fellowship

George W. Pearsall, member of the metallurgical staff, Dow Chemical Co., Midland, Mich., has been selected as the winner of the American Society for Metals Foundation Fellowship in Metallurgy. Mr. Pearsall was selected by a special judging committee who examined the entries of a number of candidates who filed for this fellowship award, which carries a cash grant of $4200 per year, with $3000 of this amount being paid to the winner and $1200 going to the school in which the winner carries on his graduate study.

*G. W. Pearsall*

George will enter Massachusetts Institute of Technology as a candidate for his Sc.D. degree in metallurgy. He is a graduate of Rensselaer Polytechnic Institute and joined Dow Chemical in 1955. He is 24 years old and a member of the Saginaw Valley Chapter.

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## *Given Scholarship to Texas Western*

*One of the 54 Winners of the $400 A.S.M. Scholarships This Year Was Dan R. Boyd, Shown at Left Accepting the Society's Scholarship Plaque From J. C. Rintelen, Jr., Chairman, Department of Mining and Metallurgy, Texas Western College, El Paso, Tex. Dan is a sophomore metallurgy student from Abilene, Tex. He is described by Prof. Rintelen as "One of the unusual individuals we often hope to find in academic work". Dan has had perfect grades, achieving A's in every subject at Western*

## Refractory Coatings Are Reviewed by Panel at San Fernando Valley Meeting

A panel discussion on "Refractory Coatings of Metals for High-Temperature Service" was held by the **San Fernando Valley Chapter** recently. E. L. Reed, Atomics International, was the moderator, and the speakers were all members of the chapter.

J. R. Blanchard, Rocketdyne Division, North American Aviation, Inc., reported on investigations he conducted while at Climax Molybdenum Co. in Detroit. The studies were concerned with the development of oxidation resistant coatings for molybdenum for service at temperatures in the vicinity of 1800° F. Several coatings were investigated. The Ni-Si-B and the Ni-Cr-B coatings were moderately successful for application at 1800° F., according to laboratory tests. One coating composition in particular, the Al-Cr-Si coating, appeared outstanding and most suitable for commercial applications over 2000° F. The coatings were subjected to a variety of laboratory evaluation tests which consisted of ballistic impact, thermal cycle (thermal shock), ductility and erosion tests. The work is still in progress; service tests are now being conducted on engine components.

Hyman Leggett of Rocketdyne discussed the use of vitreous ceramic coatings on low carbon and stainless steels. This type of protective ceramic surface has been successful for industrial and aircraft use in exhaust ducting, molten metal vessels and other high-temperature fields.

The reliability of the coatings depends on adherence to basis metal (determined by surface condition prior to application), ability of the metal to support itself, and end use of the product (service and ambient temperatures).

Samuel Sklarew, Marquardt Aircraft Co., discussed the technical aspects of flame-applied aluminum-oxide coatings. The differences and similarities of three commercial processes, the Norton "Rokide", the Metco "Thermospray" and the Linde "Flame Plating" were reviewed. Evaluation was based on the thermal insulation provided by the coating, on its ability to withstand fluctuations, vibration impact, and thermal shock on its ability to be recycled and on its surface emissivity and finish. Coatings from 0.010 to 0.100 in. thick were discussed.

Emissivity at temperature was determined by measuring the observed surface temperature by two different radiation measurement systems and determining the true surface temperature emissivity by correlating the two measurements.

Charts showing comparative thermal and mechanical data on the three coatings were shown and the significant features of each emphasized. None of the three aluminum-oxide coatings reviewed could be singled out for superior over-all performance. All appear to be able to withstand temperatures of 3000° F. and above successfully. Also, all three exhibit some flexural strength. The differences between the coatings lie primarily in degree of porosity, cost of application, ability to be thermal cycled and flexural strength bonded to a metal surface.

The talk was illustrated with slides showing the spray guns in operation and coated components for ram jet, rocket and gas turbine engines. Emissivity data obtained from specimens coated with aluminum oxide by the three different guns were presented in the form of charts.—**Reported by R. P. Frohmberg for San Fernando Valley Chapter.**

## *Presents Sauveur Lecture in Boston*

*L. Geerts, Republic Steel Corp., Is Shown, Left, Presenting a Sauveur Picture to John Fisher, General Electric Co., After He Delivered the Annual Sauveur Memorial Lecture at a Meeting of the Boston Chapter*

Speaker: J. C. Fisher
*General Electric Co.*

In presenting the 17th annual Albert Sauveur Memorial Lecture before the **Boston Chapter,** J. C. Fisher, manager, physical metallurgy section, Research Laboratory, General Electric Co., stated that Dr. Sauveur probably could have worked on the metallographic study of "Dislocations", (the title of his talk), perhaps using the same general type of microscope and etchants used when he was still active at Harvard University. The metallography of dislocations presents some challenging problems associated with understanding of microstructures. Dr. Fisher illustrated the edge type of dislocation, comparing it to a "wrinkle" in a crystal: when the wrinkle moves, one layer of atoms shears over another, producing plastic deformation.

He explained the screw type of dislocation by showing how the wrinkle is sheared sidewise instead of being compressed. Dislocations accomplish plastic deformation or slip, crystal growth, and make up grain boundaries. With respect to crystal growth, it was pointed out that perfect crystals cannot grow, and real crystals are not perfect. He explained that the spiral type of screw dislocation on crystals of silicon carbide make their growth possible. By studying cadmium iodide crystal growth, much has been learned of this phenomenon.

A study of etch pits, produced metallographically, gives a great deal of information regarding dislocations. Each etch pit, seen visually, corresponds to a dislocation. Silicon iron, when polished, bent and etched, shows etch pits and can be easily studied. Dislocations often can be revealed on precipitation.

Crystals are not orderly stacks of atoms, as normally pictured, but contain many dislocations that cause faults in the atom planes. As a crack tries to progress along one of the planes, these dislocation sites cause the crack to drop to a lower plane, or rise to a higher plane, tearing out the intervening material in the regions where cracks on different planes overlap. A highly stressed point in a crystal possibly starts its first crack. Piling up of dislocations, under plastic deformation, possibly can account for the stress concentrations necessary to actually open up a small crack.

Dr. Fisher noted that the field of metallography, so well pioneered by Dr. Sauveur, still offers challenges to the investigating metallurgist today. Our growing knowledge of plastic deformation of metals is daily being increased by the valuable work being done by research men all over the world.—**Reported by H. I. Dixon for Boston.**

# Present San Fernando Chapter Charter

*Alan Levy, Chairman of the Recently Organized San Fernando Valley Chapter Is Shown (Center), as He accepted the Chapter's Charter From National President Donald S. Clark, and National Secretary William H. Eisenman*

At the Charter Night meeting of the **San Fernando Valley Chapter,** National President D. S. Clark delivered a lecture entitled "What Do Dynamic Tests of Metals Tell Us?"

W. H. Eisenman, national secretary, formally presented the charter to the new chapter, and, in making the presentation, he pointed out some of the services offered by the American Society for Metals and how individual chapters could best participate. The growth of processing industries on the West Coast was also described, together with the role of the American Society for Metals and the Western Metals Exposition.

A report was presented which showed the growth of the San Fernando Valley Chapter in its short period of existence. At the time the chapter petition was presented last fall, there were 77 members and applicant members interested in a separate chapter. By March there were 108 chapter members with a total mailing list of 155. It is interesting to note that during the period from last summer to March this year (less than one year), a total of 40 new members were brought into A.S.M. by the San Fernando Valley Chapter.

In his address, Dr. Clark began with an analysis of the conventional impact testing of metals and pointed out some of the shortcomings of this test, particularly the inability to use the data in design formulae. A more detailed study of rapidly stressed specimens revealed very interesting behavior of strain distribution with regard to stress rate and location within the specimen. A comparison of static and dynamic properties in the region of elastic limit again showed interesting behavior. — **Reported by R. P. Frohmberg for San Fernando Valley.**

## Corrosion Problems of Atomic Reactors Cited

Speaker: Wayne Friend

***International Nickel Co., Inc.***

The **Chattanooga Chapter** heard Wayne Friend, International Nickel Co., Inc., speak on "Corrosion Problems in Atomic Reactors". Mr. Friend was one of the pioneers in the study of liquid metal systems and their corrosion problems and one of the first to point out the important role that the oxides of these molten metals played in their corrosive properties.

The purpose of an atomic reactor is to generate heat by means of the reaction of uranium or some other radioactive fuel. To utilize this heat some circulating fluid carries it from the reactor to a steam generator. Mr. Friend discussed some of these fluids and the reaction between them and various materials used to contain them.

The most widely used material for carrying these fluids is stainless steel, with the 300 series austenitic stainless giving the best service although precipitation hardening or even carbon steels can be used if the pH of the fluid is high enough. Although stainless gives the best service, it is corroded by traces of chlorides, is unsusceptible to stress corrosion and crevice corrosion when oxygen is present in the fluid and can be attacked by liquid metals and molten salts.

The fluids used to conduct heat from the reactor are water, liquid metals and molten salts. Gases and organic liquids have been tried but most organics decompose. Pure water is good to 500° F. but traces of chlorides and oxygen raise its corrosive properties. The control of purity and pH are highly important where water is used. Above 500° F., liquid metals and molten salts are used. Mercury is an example of a liquid metal used while molten sodium or a mixture of sodium and potassium is representative of the molten salts. In the use of these fluids, the presence of oxygen is to be avoided since it causes the formation of oxides which become radioactive and increase the corrosive properties of the fluid. Intergranular decomposition accompanied by mass transfer of the wall material to cooler parts of the system resulting in clogging of the system is one of the biggest problems in the use of this types of fluid.—**Reported by J. H. McMinn for Chattanooga.**

# Past Chairmen Meet in Calumet

*Present at the Past Chairman's Night Meeting Held Recently by the Calumet Chapter Were, From Left, Front: A. J. Scheid, Jr. (1951); E. W. Taylor (1949); M. A. Jones (1945); and I. N. Goff (1946). Back row, from left: E. T. Schwendemann (1950); P. H. Booth, present chairman; E. P. Epler (1943); J. R. Woodfill (1954); and F. S. Sutherland (1939)*

## Indianapolis Completes Lectures on Corrosion

The **Indianapolis Chapter** has just completed a series of educational lectures on "Corrosion and Related Problems". Lectures and speakers were as follows:

1. Chemistry of Corrosion, by N. P. Vahldieck, engineering scientist, Allis-Chalmers Manufacturing Co. Mr. Vahldieck discussed the electrochemical nature of corrosion.

2. Resistance of Metal to Corrosion," by O. B. Ellis, senior research engineer, research laboratories, Armco Steel Corp. Mr. Ellis discussed metals with resistance to corrosion in varying situations.

3. Role of Protective Coatings in Corrosion Prevention, by K. G. Compton, Bell Telephone Laboratories, Inc. Mr. Compton covered metallic, nonmetallic, organic and inorganic coatings for corrosion prevention.

4. High-Temperature Corrosion, Its Nature and Problems, by John R. Schley, Haynes-Stellite Co. Mr. Schley discussed the common forms of oxidation, the newer problems of oxidation and prevention of these forms of corrosion.

The meetings were informative and interesting and well attended. Some new ideas were gained and old ones refreshed from this series.—**Reported by Dorothy Holbrook for Indianapolis Chapter.**

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## Chicago-Western Has Its Own Spark-Plug

The combined Chicago—Chicago-Western Chapters' Ladies Night Meeting, consisting of a fine dinner, a 40-min. concert supplied by the Lindberg Chorus and a style show, drew an unusally large attendance of close to 300, so many that tables for 12 had to be re-arranged to accommodate 14 persons each.

Carl Swartz, chairman of Chicago-Western, sums up the success of this event as follows: "As a result of this added experience I am confident that A.S.M. is right in trying to build enthusiasm and drive into the local chapter officers.

Every A.S.M. chapter must have a spark plug or more than one at all times, someone to keep track of things and to provide the incentive and push necessary to keep the chapter active at all times. If we could only somehow have this in every chapter we would have a combination that would be unbeatable".

It would not take long to find the nominee for the spark plug of the still-new Chicago-Western Chapter which has just completed a highly successful year of meetings, plant visits and educational activities.

## *New Haven Tours Bridgeport Tube Mills*


*A Combination Plant Tour-Technical Meeting Was Held Recently by New Haven Chapter. An unusually large group of members toured the tube mills at Bridgeport Brass Co. and later heard Gilbert Mott, director of engineering at Bridgeport discuss the "Engineering and Planning of a Modern Tube Mill". A movie, "The White-Tailed Buck" was shown between the tour and the talk. Present were, from left: Lloyd E. Raymond, technical chairman; Mr. Mott; and Ed Holtberg, chairman. (Reported by James Baker)*

## *Ladies Meet in Montreal*

*The Montreal Chapter's Annual Ladies Night Was Recently Enjoyed by Members and Their Ladies. Shown, from left: G. M. Young, A.S.M. Vice-President, and Mrs. Young; Mrs. and Mr. K. W. Shaw, incoming chairman; and Mrs. and Mr. Arnold Boehm, past chairman. Mr. Boehm proposed a toast to the past chairmen of the chapter which was replied to by R. W. Bartram, who traced the history of the chapter from its inception. Entertainment and a light talk completed the evening's activities*

## *Tulsa Signs Up Student Members*

*George Clay (Right), Chairman of the Tulsa Chapter, Is Shown Accepting Applications for A.S.M. Membership From University of Oklahoma Students During the Annual Students Night Meeting Held by the Chapter. National President Donald S. Clark was guest speaker at this meeting*

## At New England Regional Meeting

*Shown During the New England Regional Meeting Held Recently in Boston Are, From Left: S. Demirjian, General Electric Co., Technical Chairman; T. Shidler, General Electric Co., Guest Speaker; J. Heger, U. S. Steel Corp., Speaker; and H. Stuck, Chairman of the Boston Chapter*

The New England Chapters A.S.M. (**Boston, Hartford, New Haven, Rhode Island, Springfield and Worcester**), met for a one-day regional meeting in Boston on May 10, 1957. Technical talks on "New Developments in the Steel Industry" and "Small Gas Turbines — Their Challenge and Promise to the Metals Industry", were presented by J. J. Heger, chief research engineer, stainless steel, U. S. Steel Corp., and T. W. Shidler, manager, advance engine design, Small Aircraft Engine Department, General Electric Co. Tours to CBS, Hytron, in Danvers, Mass., General Electric Co., in Lynn, or the U. S. Army Quartermaster Research and Development Center in Natick were taken by most of the members attending the meeting.

The guest speaker at the banquet held in the evening was Walter R. Dornberger, guided missiles consultant, Bell Aircraft Corp., who presented a talk entitled "High Speed Rocket Flight". A report of Dr. Dornberger's address, as reported in the *Boston Traveler,* May 16, follows:

A former rocket warrior, who now thinks war is nonsense, feels that man must go personally into space to solve the problems of space travel. Dr. Dornberger is ready to go as soon as the U. S. Government will pay for construction of a space ship.

Dr. Dornberger, at one time commanding general of Germany's giant rocket station at Pennemuende, supervised the development of the V-1 and V-2 rockets, which might, he stated, have won World War II for Hitler if they had been used in the early fighting.

His dream is of the day when man will be able to leave this planet and go traveling in space. According to Dr. Dornberger, it's just a matter of money; the technical problems of space travel are 90% solved. With the appropriate bankroll behind the project, we could whip into outer space within five or six years, he said, but, to do the job right, we must do it with a manned rocket, not just with a carload of instruments.

We're concentrating too much on automatic gimmicks and too little on the abilities of man. Man is a remarkable instrument, created by God and endowed with remarkable powers, the powers of judgment, of reason, of free will. What good would it do us to build a moon rocket, load it with instruments and send it on a journey around the satellite and back? All it would prove would be that we can get there. We know that already. The information it would bring back would be scanty and primitive compared to the information available.

What we need is a rocket that can carry a man into space and return with a safe landing. We need to have somebody who can step out of the rocket, carry his books and boxes into the office and say, "I was there. Here's what it's like".

Dr. Dornberger is convinced that we are ready now to start such a space project, but is skeptical of the chances of the U. S. Government or anyone else coming up with the money to finance the project. Nobody invests millions in a project that returns no profits, he said, unless, of course it's war.

And, speaking of war, the former German general has some positive opinions on that too. Within a few years, he said, we'll have defensive rockets capable of knocking down intercontinental hydrogen missiles. And, if the United States and the Soviets ever start hurling such weapons at each other, man will be on a swift journey toward self-destruction. War is useless; man must not desert his common sense and start another one, or he would only be destroying himself.

The V-2 rocket was 75% accurate. Perhaps the intercontinental missiles will be that accurate also. If they are, that would mean that 25 out of every 100 hydrogen-armed missiles would miss their target. They might hit a neutral country, they might swing around crazily and hit the country they started from. Man can develop great mechanical instruments, but he can never be sure that they'll always work. And when they fail, watch out.

The only solution Dr. Dornberger said, is to find the way to end all wars, which is up to the politicians and the statesmen—not the military. Another war could mean total destruction. If people of all backgrounds can get along in the United States, as they do so well, then they should be able to get along in the rest of the world. We must find the way to give them that chance, Dr. Dornberger stated, and, when we do, then at last man can concentrate on getting to the stars.

## Surveys Trends in Field Of Engineering at Muncie

**Speaker: A. R. Spalding**
***Purdue University***

A. R. Spalding, head of the department of freshman engineering, was the speaker at the **Muncie Chapter's** annual Student Night. His subject was "Trends in Engineering Education".

A major portion of his talk was directed to the group of high-school students, teachers and school officials who were present as guests. Emphasis was placed on the higher standards being set and the acceleration of the work in the college engineering curriculum. The importance of proper selection of subjects in the high school, with attention given to adequate coverage of mathematics, science, English and other basics was pointed out as being essential.

Dr. Spalding noted that a combination of increased applications for admittance together with industrial advances has caused colleges and universities to raise their standards and become more selective. The student who is inadequately prepared for college, or who is unable or unwilling to meet the pace will necessarily be denied admittance, or will be dropped from enrollment at an early date in his college career.

A lively discussion period followed the talk, with the students present taking a large part in it. This type of program is felt to be helpful and stimulating to the chapter as a whole as well as to the students.—**Reported by R. R. Myers for Muncie.**

## Activities of A.S.M.'s Documentation Groups

A.S.M. activities in the field of documentation (indexing, abstracting, classification and new methods of literature retrieval) were presented before three different governmental departments or offices during a single week in the month of May. During that week invitations were accepted by A.S.M. to send representatives to meetings held by the Department of Defense in Washington, the National Research Council of the National Academy of Sciences (also in Washington), and the Navy Department in New London, Conn.

At the Pentagon in Washigton on May 16 a meeting was held of a committee known as the Study Group on Information Centers. The committee consisted of representatives of the Army, Navy, Air Force, the Materials Advisory Board and the National Academy of Sciences. This Study Group is analyzing the documentation activities of the various divisions of the Defense Department with a view to possible correlation so as to reduce duplication of effort. Another purpose of this meeting was to review the status of several existing information centers on specific subjects, and assess the present state of development along this line. The American Society for Metals was invited to send representatives who could present a progress report on the experimental Mechanized Searching Project at Western Reserve University, which will point the way to eventual establishment by the Society of an information center on metallurgy.

The presentation, which covered all of the activities of A.S.M. in this field, were made by Ernest E. Thum, editor of *Metal Progress,* Marjorie R. Hyslop, managing editor of *Metal Progress* and Allen Kent, associate director of the Center for Documentation and Communication Research at Western Reserve University. They described the history and development of the A.S.M. Review of Metal Literature (abstracting service), the ASM-SLA Classification of Metallurgical Literature and punched card searching system, hand-sorted, and the experimental Pilot Plant Project for machine literature searching at Western Reserve University, financed under a five-year contract with the American Society for Metals.

The second presentation, made at the National Academy of Sciences on May 20, was occasioned by the annual meeting of the Division of Industrial and Engineering Research of the National Research Council. On this occasion, Frank T. Sisco, director of the Engineering Foundation, spoke on the "Importance of Documentation". Mr. Sisco has been chairman of the A.S.M. Literature Classification Committee for the past two years and has just been named chairman of the new A.S.M. Standing Committee on Documentation recently appointed by the Board of Trustees. He summarized the A.S.M.'s contributions toward solution of the growing problem of documentation and literature retrieval, and indicated the direction of future efforts.

Finally, a meeting of East Coast Naval librarians, representing Navy installations from Florida to Maine, was held at the Navy Underwater Sound Laboratory in New Haven, Conn., on May 23. At this event the American Society for Metals was invited to present a description of the ASM-SLA Metallurgical Literature Classification and Punched Card System. This presentation was made by Marjorie R. Hyslop, managing editor of *Metal Progress* and editor of A.S.M.'s abstracting service, the Review of Metal Literature.

## Precipitation Hardening Steels Topic in Washington

Speaker: M. E. Carruthers

*Armco Steel Corp.*

M. E. Carruthers, Research Laboratories, Armco Steel Corp., presented a talk entitled "Precipitation Hardening Stainless Steels" at a meeting held by the **Washington Chapter.**

The speaker made clear that these are specialty steels with narrowly defined properties. They are all characterized by high strength-to-weight ratios, strength at elevated temperatures, producibility in the mill and adaptability to fabrication. He then proceeded to give individual analysis of the principal numbers of this new family of steels, indicating their special advantages and limitations, covering 17-7 Ph, PH 15-7 Mo, 17-4 PH, AM-350, and Stainless W.—**Reported by F. P. Huddle for Washington.**

## *Temperature Control Oak Ridge Topic*

*E. E. Stansbury, University of Tennessee, Spoke on "Measurement and Control of Temperature in Scientific Research and Development" at a Meeting Held in Oak Ridge. Shown are M. L. Pickelseimer and Dr. Stansbury*

Speaker: E. E. Stansbury

*University of Tennessee*

E. E. Stansbury, professor of metallurgical engineering, University of Tennessee, presented a discussion on the "Measurement and Control of Temperature in Scientific Research and Development" at a meeting held by **Oak Ridge Chapter.**

The discussion was centered around temperature sensing devices, primarily thermocouples, and the difficulties which arise in making very accurate high-temperature measurements such as are required in high-temperature calorimetry, materials testing or equipment operation (i.e., nuclear reactors).

The historical development of thermocouples was traced from the discovery of the Seebeck effect to the present time. The desirable properties of a thermocouple were listed as: a high termal emf.; physical and chemical homogeneity; good stability under operating conditions; and a high melting point.

The advantages and disadvantages of the iron-constantan, chromel-alumel, platinum-platinum + rhodium and other thermocouple materials were discussed with respect to the above functions, and the difficulties in establishing accurate temperature scales were mentioned.

Thermocouples in use may undergo changes due both to reaction with the environment and internal changes. Fabrication and processing may result in structural instabilities which later cause a drift in temperature measurement. Environmental reaction is even more prone to cause errors, and even the method of attaching the thermocouple may have an effect. — **Reported by A. Goldman for Oak Ridge.**

## *Describes Service Performance Factors*

*R. A. Flinn, Professor, University of Michigan, Spoke on the "Relation of Metal Structure to Service Performance" at a Meeting in Northwestern Pennsylvania. Shown are, from left: G. E. Mohnkern, vice-chairman; G. D. Kimpel, chairman; Prof. Flinn; and L. A. Hauser, technical chairman*

Speaker: R. A. Flinn
***University of Michigan***

Members of the **Northwestern Pennsylvania Chapter** heard a discussion on the "Relation of Metal Structure to Service Performance" by R. A. Flinn, professor at the University of Michigan, at a recently held meeting.

The speaker presented five major factors upon which service performance depends—service conditions, internal stresses, design, soundness and the structure of the material. Other factors may contribute to premature failure which may not be evident in the structure and in such instances it is highly desirable to examine them to find the proper solution.

In a general discussion of the factors contributing to service performance, Prof. Flinn discussed several ways in which a change in the structure of the material can be accomplished, and several fields of performance which are directly associated with service performance.

Microhardness testing of the various phases within a material was described and the use of the strain viewer and its application to service problems and the part the electron microscope can play in the examination of service failures were also discussed.

Slides were shown illustrating microhardness testing, the strain viewer, abrasion testing, lubricated wear, nonlubricated wear and the use of the electron microscope in evaluating the structure of heat resisting metals.—**Reported by W. W. Lynch, Jr., for Northwestern Pennsylvania.**



## Lectures on Dislocation Theory in New Jersey

Speaker: D. F. Gibbons
***Bell Telephone Laboratories, Inc.***

D. F. Gibbons, Bell Telephone Laboratories, Inc., presented a lecture on "Dislocations and What They Mean to the Practical Metallurgist" at a meeting in **New Jersey.**

The speaker prefaced his talk by a reminder that metallurgy is still predominantly an art with a little science added. As an art, metallurgy has been practiced for nearly 4000 years, whereas dislocation theory is a mere child, 30 years old, and so we cannot expect dislocation theory to revolutionize metallurgy overnight.

The dislocation theory was introduced by means of a historical survey showing why the need for such a concept arose and describing some of the more important steps in its growth to maturity. Evidence which has been amassed to substantiate the existence of dislocations was described chronologically, starting with the simple two-dimensional bubble raft model, through crystal growth spirals and dislocation etch-pit techniques to the most recent direct electron microscope evidence in crystals of platinum phthalocyanine. Emphasis was placed upon the three-dimensional character of dislocation theory and that this viewpoint led to the concept of the Frank-Read source, which is such an important cornerstone in dislocation theory.

Mr. Gibbons pointed out that because metallurgy has flourished for so many years as a practical art, many predictions which dislocation theory could have made were anticipated by the ingenuity of many generations of metallurgists. However, two areas were reviewed to show that dislocation theory in one case answered "how" and in another is helping to gain an understanding of metallurgical engineering problems. The first example was the use of "leveller rolling" prior to severe deep drawing operations in mild steel and its connection with the strain aging phenomenon. The second was the understanding of work hardening by models involving the interaction of dislocations with each other and other stress fields in the metal.

A few short remarks were made on the importance of metal "whiskers" in the field of plastic deformation, since they behave as if they were perfect crystals. Two films were shown to emphasize certain aspects of dislocation theory. The films were the Bragg Bubble model film and the General Electric crystal growth film.—**Reported by M. Margolis for New Jersey.**

## *Clark at Students Night in Tulsa*


*Donald S. Clark, President A.S.M., Presented a Talk on the "Dynamic Properties of Metals" at the Students Night Meeting Held Recently by the Tulsa Chapter. Dr. Clark is shown discussing opportunities in metallurgy and engineering with a few of the students who attended the meeting. George Clay, Tulsa chairman, is shown second from left*

## Letter From Scotland

James R. Munro, director of manufacturing, Caterpillar Tractor Co., Glasgow, Scotland, recently sent the following letter to Secretary W. H. Eisenman, which is being reproduced as an indication of the world representation enjoyed by the Society.

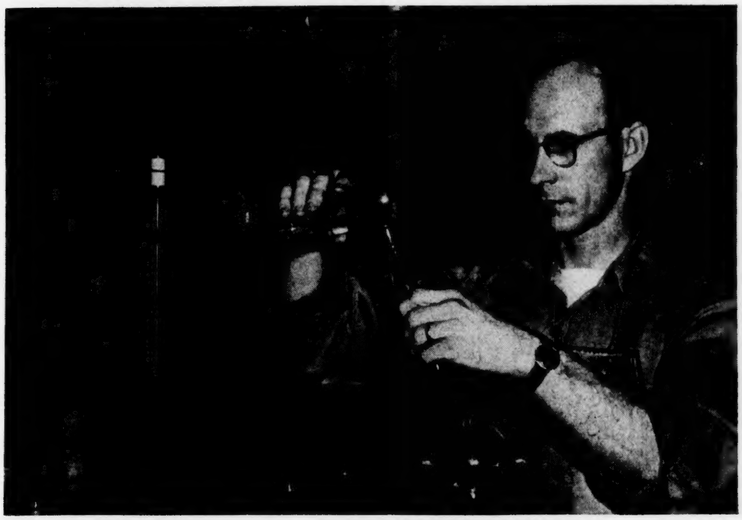
"It has been a year past now since I, family included, have established residence here in Scotland. If you are not aware of it, Caterpillar is building a sizeable factory in Glasgow for the production of crawler tractors and it has been my responsibility to see that such gets built and operating. Needless to say, it has been a most interesting experience, worth all the trials and tribulations attached to it.

"We are installing, in a 600,000 sq. ft. factory, plant facilities to produce the counterpart of two models of crawler tractors now produced in Peoria, Ill. These, of course, include the necessary heat treating equipment, which is still an old love with me.

"In your recent letter, you mention my membership in the A.S.M. dating back to the mid-20's. That also dates our first acquaintance, when you had occasion to be visiting the Golden Gate Chapter on the West Coast.

"*Metal Progress* has been reaching me here, which, when finished with, is being passed on to our staff of Scots having an interest in the field of metals. I can assure you that they find the contents good reading and informative".

## *M.E.I. Reports on Its First Student*



*Glen C. Boyce, Chemist and Foreman of the Iowa Malleable Iron Co., Was Accepted as the First Student of A.S.M.'s Metals Engineering Institute*

The correspondence school of the metals industry, A.S.M.'s new Metals Engineering Institute, has begun accepting applications for home study in four of its 40 projected subjects. These are: Elements of Metallurgy, prepared under the direction of Ralph E. Edelman of Pitman-Dunn Laboratories, Frankford Arsenal; Heat Treatment of Steel, by George F. Melloy of Bethlehem Steel Co.; High-Temperature Metals, by C. L. Clark, Timken Roller Bearing Co.; and Titanium, edited by Walter L. Finlay, Rem-Cru Titanium Corp.

Glen C. Boyce, 31, chemist and foreman of the Iowa Malleable Iron Co., Fairfield, Iowa was accepted as the first student in A.S.M.'s Metals Engineering Institute. He writes: "I am enjoying this course very much. The fact that the study material parallels my work makes both my work and studies a great deal more interesting".

About 65 students are already enrolled and have started on their studies, some on their own and others in classes organized by their companies.

Other courses now in advanced stages of preparation include Metals for Nuclear Power, Electroplating, Steel Foundry Practice, Stainless Steels, Oxy-Acetylene Welding, Lead and Zinc, Steel Plant Processes and Gray Iron.

Most of the texts are aimed at the "man at the fire" and are written in easy-to-understand language, avoiding advanced mathematics and complex theory. "We try to teach a man what he needs to know to do his job better, or to take on a better job", explains M.E.I. director, Anton Brasunas. "Although most of our courses can be handled with a high-school background, or a year of college, a few are more advanced and would require the equivalent of a B.S. degree in metallurgy. Metals for Nuclear Power by D. W. Lillie of General Electric Co. is one of the more advanced type of courses."

An unusual interest in the M.E.I. home-study courses has been expressed by the training divisions of numerous large and small companies which visualize how these courses can be adapted for in-plant training.

Persons interested in learning more about the Metals Engineering Institute are urged to write to A.S.M. headquarters, 7301 Euclid Ave., Cleveland 3, Ohio, for further details.

## *Presents Talk on Micrometallurgy*

*Harry L. Hovis, Superintendent of Metals Processing, Hamilton Watch Co., Spoke on "Micro Metallurgy" at a Meeting of Long Island Chapter. Mr. Hovis' talk dealt with unique specialty heat treating and fabricating problems in the instrument field having to do with titanium, tantalum, hafnium and other special metals and alloys. He described the use of a "miniature steel mill" for drawing thin wire and rolling thin strip down to as low as a tenth of a thousandth inch thick. Shown at the meeting are, from left: G. W. Corrie, technical chairman; Mr. Hovis; and C. P. Sammis, vice-chairman. (Reported by R. H. Witt for Long Island)*

# Explains Water Resource Development

*Ted B. Mathisen, (Left), Chairman of the Oregon Chapter for the 1957-58 Season, Is Shown With Ralph H. Millsap, Vice-President, Portland General Electric Co., Who Presented a Talk on "Recreation—an Important Phase of Water Resource Development" at the Ladies Night Meeting in Oregon*

Speaker: R. H. Millsap
*General Electric Co.*

A nonmetallic program proved a popular event for the Ladies Night Meeting held recently by the **Oregon Chapter.** Ralph H. Millsap, vice-president, Portland General Electric Co., presented a talk entitled "Recreation — an Important Phase of Water Resource Development".

The conservation policy of Portland General Electric in relation to the development of hydro-electric facilities was explained. As PGE puts rivers and water to work for the generation of power, public recreation facilities are constructed to provide camping, picnicking, boating and other outdoor activities. This use stresses continued use of the area, erasing some of the stigma that heretofore has been attached to such construction in wilderness or semiwilderness areas and, at the same time, providing something for public use that wasn't there before.

As an example of this development, Mr. Millsap used Timothy Lake, a 1400-acre reservoir formed by PGE near the crest of the rugged Cascade Mountain Range in the Mount Hood National Forest, 74 miles from Portland. Timothy Lake was a meadow with several streams crossing it before PGE moved in to form the lake as a reservoir of water to bolster downstream hydro-electric generation in low flow periods of the fall and winter.

Three forest camps will be provided around the man-made lake, largest body of water in lake-dotted Mount Hood National Forest. The natural setting around the lake was disturbed only as was necessary to provide adequate facilities for visitors, who will find a full lake of constant level through the summer months when recreation use is most desired.

This area was reached only by trail until PGE moved in. Construction required access roads. Now the lake is added, recreation benefits and easy access to the heart of a 100 sq.-mile area is possible. Before the Timothy project, only the hardy outdoorsman, and only after a long hike or pack-in, could enjoy the area. The road also permits conservation of valuable timber resources. Overage timber is salvaged and the marketing of other trees is possible under the sustained yield policy of the U. S. Forest Service.

At Timothy native trout in the streams have been supplemented through plantings of other species by the Oregon State Game Commission. Thus the lake and its tributary streams promise to be a highly popular and productive trout-fishing resource.

The camping facilities at Timothy are being constructed and will be maintained by PGE under a cooperative agreement with the Mount Hood National Forest. Also mentioned was another benefit of advanced planning. The borrow area from which material for the rolled, earth-fill Timothy dam was excavated was left in a flat condition. This area will be developed by the State in cooperation with the U. S. Forest Service as a small plane landing field.

Mr. Millsap's talk was illustrated by color slides, which indicated the thoughtful planning of the Timothy campgrounds and their equipment. Timothy is one of seven locations developed or under development for multiple conservation benefits in conjunction with hydro-electric projects.- **Reported by Arthur H. Greisser for Portland.**

# Pittsburgh Hears Rapid Heating Panel


*A Recent Meeting Held by the Pittsburgh Chapter Featured a Panel Discussion on the "Rapid Heating of Steel". Members of the panel included B. E. McArthur, Magnethermic Corp., who spoke on "Low Frequency Induction Heating of Steel"; Edward N. Case, Ajax Electric Co., who discussed "Salt Bath Heating of Steel"; and Q. M. Bloom, Selas Corp. of America, whose topic was the "Rapid Heating of Steel by Gas". A 25-year membership award was presented during the meeting to Gilbert Soler for Universal-Cyclops Steel Corp. Pictured is the speakers' table during the award presentation. (Reported by H. W. Paxton for Pittsburgh)*

## Metallurgical Careers Discussed at Penn State

### Speakers: R. S. Pratt
### D. I. Dilworth

The speakers at a recent meeting of the **Penn State Chapter** were Roydon S. Pratt, technical director, Bridgeport Brass Co., and David I. Dilworth, director of metallurgy, Crucible Steel Co. of America.

Mr. Pratt opened his talk, "Opportunities and Trends in Nonferrous Metal Industries", with an examination of the expansion of the nonferrous industry in recent years. He mentioned briefly such metals as aluminum, titanium and zirconium, which have played such an important part in this expansion. He stressed the need of continued research involving these elements so that a more complete understanding of their fundamental properties may be obtained and they can be adapted to cheaper commercial production.

He then enumerated and discussed points upon which an employer tries to evaluate a new man. Will the new man be completely honest in his approach to a job? It is essential that he presents the facts as he finds them, not as he thinks the boss wants them. Will the new man be able to work well with other people? This is a difficult question to answer and is an important one. Mr. Pratt feels this point is most important in the smaller plants where people must work more closely together than in the highly departmentalized organizations.

Common sense, coupled with a good scholastic standing, is to be considered by the employer who, at the same time, must recognize that scholastic standings can sometimes be misleading.

The prospective employee should have a good sense of purpose; that is, he should know why he wants to work for a company, and he should show a willingness to work more than just the required eight hours a day.

Mr. Pratt concluded by comparing Russian and American graduates. He believes that people who are free to choose their path through life will prove to be superior to those who have no choice in the matter.

Mr. Dilworth's speech was entitled, "Guides in Planning a Metallurgical Career".

Mr. Dilworth believes that if an individual is going to make a success of himself, he must accept every job as a challenge. He must always think about future possibilities, and he must develop and expand any ideas which come into his mind.

He named the four general areas in which a graduate can seek employment — production, sales, research, and service—and he stressed the need to obtain the proper background for the area which the graduate decides to enter. A knowledge of production methods will help the graduate to obtain the proper background and will give him an understanding of his position in the overall scheme.

It is necessary that one accepts and assumes responsibilities in industry if he is going to gain success. Most companies today have training programs which help men to gain the know-how so that they can assume these responsibilities.

The demand for metallurgists is steadily increasing. Some fields (such as nuclear reactors and aircraft industries) are still in their infancy, or in a continual state of development, and they represent an ever-increasing demand for the metallurgist who is able to think.

Mr. Dilworth concluded his talk with a warning to the graduate. The graduate must realize that a degree from college is no guarantee to success and that he must constantly think and apply himself to his job if he is to gain that success.—**Reported by D. Toland for Penn State.**

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### A.S.M.-W.R.U. Program Ready for Test Runs

*The pilot plant mechanized literature searching project being conducted for the American Society for Metals at Western Reserve University has now reached the initial testing stage. More than 5000 abstracts representing much of the important metallurgical literature of 1955 have been processed and will be ready for machine searching in September. An experimental searching selector has been built at the Center for Documentation and Communication Research at Western Reserve University which can be used to make test searches.*

*members are urged to participate in the test program by submitting typical questions and subjects for literature searches. A limited number of searches will be made covering only the literature of 1955. For those problems selected, pertinent information retrieved will be sent to the inquirer at no charge.*

*For details, write:*

*American Society for Metals*
*Attention: Marjorie R. Hyslop*
*7301 Euclid Ave.*
*Cleveland 3, Ohio*

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## Explains A.S.M.'s Plans For Education at Purdue

### Speaker: A. de S. Brasunas
*American Society for Metals*

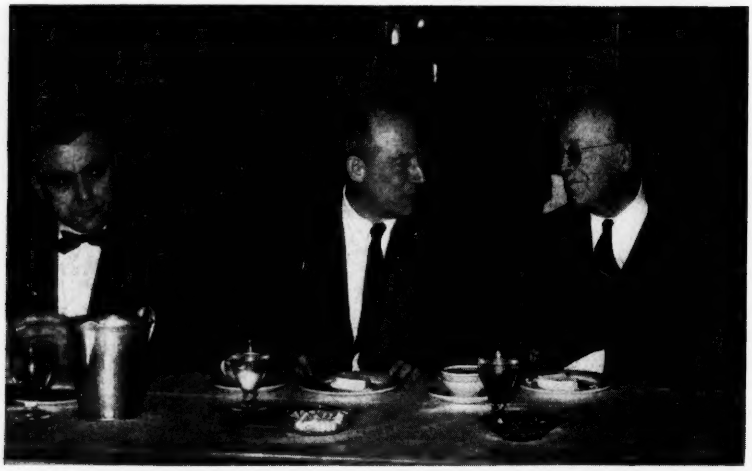
The final meeting of the 1956-57 season of the **Purdue Chapter** featured a talk by Anton de S. Brasunas, director, A.S.M. Metals Engineering Institute. Dr. Brasunas presented an informative talk on the educational program of the American Society for Metals. He pointed out that the current shortage of metallurgical engineers will exist for some years to come, and A.S.M. has chosen to undertake an ambitious program for the distribution of information to grade and high schools to attract qualified persons into the metallurgical field.

It is unfortunately true that a great many of the present-day metallurgists came into this occupation through the "back door", which indicates a need for guidance information, particularly at the high-school level. Currently, A.S.M. is active in cooperating with the National Science Teachers Association, and at the college level, A.S.M. is providing for undergraduate scholarships in 55 schools and for fellowship awards in the graduate schools. Several other projects are also under consideration.

Dr. Brasunas mentioned an A.S.M. Seminar Institute which would provide for the education of various metallurgical groups at all levels and in all phases of metallurgy. Also being considered is an A.S.M. Research Institute to undertake studies of a metallurgical nature not being pursued by other research organizations. A third project is a Metal Science University which would take students, probably at the undergraduate level and give them the most up-to-date metallurgical course of study possible in the United States.

Finally, Dr. Brasunas described in detail the operation of the division of A.S.M. with which he is affiliated, the Metals Engineering Institute. He explained that there will soon be available to the metals industry correspondence courses in 40 metallurgical and allied subjects which are being written for persons at a subcollege level. Four of the courses are now complete and are being used by individuals and for in-plant training groups throughout the United States and Canada.—**Reported by K. H. Schneck for Purdue.**

# Discusses Failure Analysis of Metals



*Alfred Borneman, Chairman of the Department of Metallurgy, Stevens Institute of Technology, Presented a Talk on "Failure Analysis of Metals" at a Meeting Held by the New Jersey Chapter. Shown at the speakers' table are, from left: J. Hauptly, chairman; Dr. Borneman; and S. Skowronski*

Speaker: A. Borneman

*Stevens Institute of Technology*

Members of the **New Jersey Chapter** heard Alfred Borneman, chairman of the department of metallurgy, Stevens Institute of Technology, speak on "Failure Analysis of Metals" at a recent meeting.

Dr. Borneman emphasized the importance of combining engineering knowledge with metallurgy to determine cause for failures. It is common for people, including engineers, to blame failures on substandard material without a thorough investigation. Therefore a metallurgist must be familiar with engineering principles and good design practice to make complete analyses. Factors frequently involved in the cause for failures are design, choice of materials, craftsmanship and environment. It is essential to document the following type of data for a failed part—the manner in which the part was used and its environment, chemical analysis, macro and microscopic examinations, physical properties with consideration of the effects of section size and shape, and the characteristics of the failure.

Failure which occurs when a part has insufficient elasticity to return to its original dimensions was described. An illustration of two steel rods having the same hardness but exhibiting different degrees of elasticity was shown. One rod was hardened by heat treatment and the other, having less elasticity, was hardened by cold work. The effect of the direction of stress on brittle and ductile metals was described. For example, tensile stress caused cleavage failures in brittle materials which have a granular appearance at the fracture surface. Fatigue-type fracture was said to have occurred in 90% of failed mechanical parts. Frequently parts fractured by fatigue failures have a fine texture with "beach marks" on portions of their fracture surface. Dr. Borneman described how the curvature and spacing of the "beach marks" indicate the nucleus and rate of fracture of a fatigue failure.

A number of excellent slides illustrated examples of failures due to the most common causes. A broken rigging shackle which should have been made of hardenable steel to have sufficient strength for its design was shown. Microscopic examination revealed the manufacturer chose a steel which could not be heat treated to provide the required strength. Micrographs illustrated substandard material having nonmetallic inclusions which were starting points of fractures. Poor craftsmanship was exemplified by the lack of the proper amount of forging work in the broken link of an anchor chain which left several thousand dollars worth of anchor stranded at the bottom of the Caribbean Sea. An example of poor design was brought out in a discussion of the failure of bolts which supported a load at one corner of their heads. Proper designing would have provided the type of washer under the bolt head that would distribute the load evenly.

Dr. Borneman concluded with a reminder that engineering should be combined with metallurgy in failure analysis.—**Reported by Arnold Klein for New Jersey.**

# Presents Talk on Arc-Cast Molybdenum

*Robert R. Freeman, Climax Molybdenum Co., Spoke on "Arc-Cast Molybdenum and Molybdenum-Base Alloys" at a Meeting of the Los Alamos Chapter. At the speakers' table are, from left: Mr. Freeman; W. N. Miner, chairman; and Frank Kubosch, past chairman and 25-year member of the Society*

Speaker: Robert R. Freeman

*Climax Molybdenum Co.*

At a recent meeting of the **Los Alamos Chapter**, Robert R. Freeman of Climax Molybdenum Co., presented a talk entitled "Arc-Cast Molybdenum and Molybdenum-Base Alloys".

Until World War II, pure molybdenum was used mainly in lamps and electronic tubes. Mr. Freeman outlined the development of the arc-casting technique which now permits production of molybdenum ingots weighing as much as 1000 lb., and noted that development work is presently concerned with alloys of molybdenum because of their much better high-temperature properties.

Mr. Freeman then compared the mechanical properties of pure molybdenum with those of its alloys and showed that both are sensitive to processing variables.

The rest of the talk concerned commercial availability, fabrication techniques, protective coatings and new applications for these materials. Excellent illustration was provided by a series of well-chosen slides.

At the dinner which preceded the talk, a 25-year certificate was presented to Frank Kubosch, a charter member and past chairman of the Los Alamos Chapter.—**Reported by H. L. Brown for Los Alamos.**

# Metallurgical News and Developments

***Devoted to News in the Metals Field of Special Interest to Students and Others***

A Department of *Metals Review*, published by the
American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio

**Nuclear Plant**—The Nuclear Materials and Equipment Corp., with offices in Pittsburgh and in Apollo, Pa., has been formed, with Z. M. Shapiro, A.S.M., as president, and Frederick Forscher, A.S.M., and Leonard Pepkowitz, as vice-presidents. The firm renders service and products for the nuclear power industry.

**Set Up Lab**—The Metals Research and Development Corp. has established and will act as a laboratory and consulting service to industry and governmental agencies. It will perform work in the metals, cermets and ceramics area, specializing in nuclear reactor core component work and such fields as powder metallurgy, bonding, metal powder rolling, high-temperature alloys, refractory metals and rare earth metals.

**Changes Name**—The name of the Olin Revere Metals Corp. has been changed to Ormet Corp. Ormet is jointly owned by Olin Mathieson Chemical Corp. and Revere Copper and Brass, Inc.

**Metallurgical Heart**—Metallurgy and medicine have combined forces to develop the first metal spring ever used to repair a human heart. Made of Elgin National Watch Co.'s mainspring material, "Elgiloy", Y-shaped springs were experimented with first in dogs. A diamond-shaped spring wrapped with nylon finally was placed in a Detroit woman's heart. Surgeons estimate it already has functioned over 40 million times.

**Bigger Boxes** — Foil-covered cartons in larger sizes will be available soon from a new Reynolds Metals plant in Richmond, Va., where four high-speed, seven-color presses will handle 44-in. stock instead of the usual 24-in. or 30-in. width.

**Care-Free Homes**—Aluminum Co. of America is canvassing the country for builders to construct "care-free" homes using a maximum of aluminum inside and out. The company hopes to enlist about 50 contractors to put up the Alcoa-designed one-story houses at their own cost. Alcoa will supply aluminum and publicity.

**Announce Course**—The second annual course on "Investment Castings", sponsored by the Investment Casting Institute, will be held at M.I.T. the week of Sept. 9-13. It will be under the direction of N. J. Grant and Howard F. Taylor and will include lectures, laboratory exercises and demonstrations.

**Fusion Research**—Safe and inexpensive power from the fundamental process of the hydrogen bomb is the goal of a scientific search that has been launched at General Electric Co.'s Research Laboratory in a research program set up to study the fusion process.

**Symposium**—A symposium on "Computers and Data Processing" will be held Aug. 29-30, at the Albany Hotel in Denver, Colo. Information from: J. Marshall Cavenah, Electronics Division, Denver Research Institute, University of Denver, Denver 10.

**Adds Division**—The new Pelletizing Division of Surface Combustion Corp. will market and engineer the process and equipment for complete pelletizing plants. Arthur W. Storm has been appointed chief engineer.

**Awarded Contract** — Solar Aircraft Co. has received a $1,384,000 supplementary contract for gas-turbine-powered airborne generator sets from the Air Force's Air Materiel Command. The sets will be powered by Solar's 50-hp. Mars gas turbine engines and will be installed in the Boeing KC-97 tanker.

**To Build**—Stevens Institute of Technology has begun construction of a seven-story science-engineering building which will gather under one roof the departments of physics, metallurgy and electrical engineering in an effort to foster a closer working relationship between scientists doing research in different disciplines. The third and fourth floors will be used by the metallurgy department which is conducting research into high-speed and high-temperature metals and new techniques in powder metallurgy.

**Joins Study Group**—Clevite Corp. of Cleveland, producers of electronic equipment, bearings and ordnance, has become a participant in the Case Industrial Nuclear Center Study Group, the seventh corporation working with the Institute towards what is hoped will be the construction and operation of a nuclear research development and testing center in Ohio.

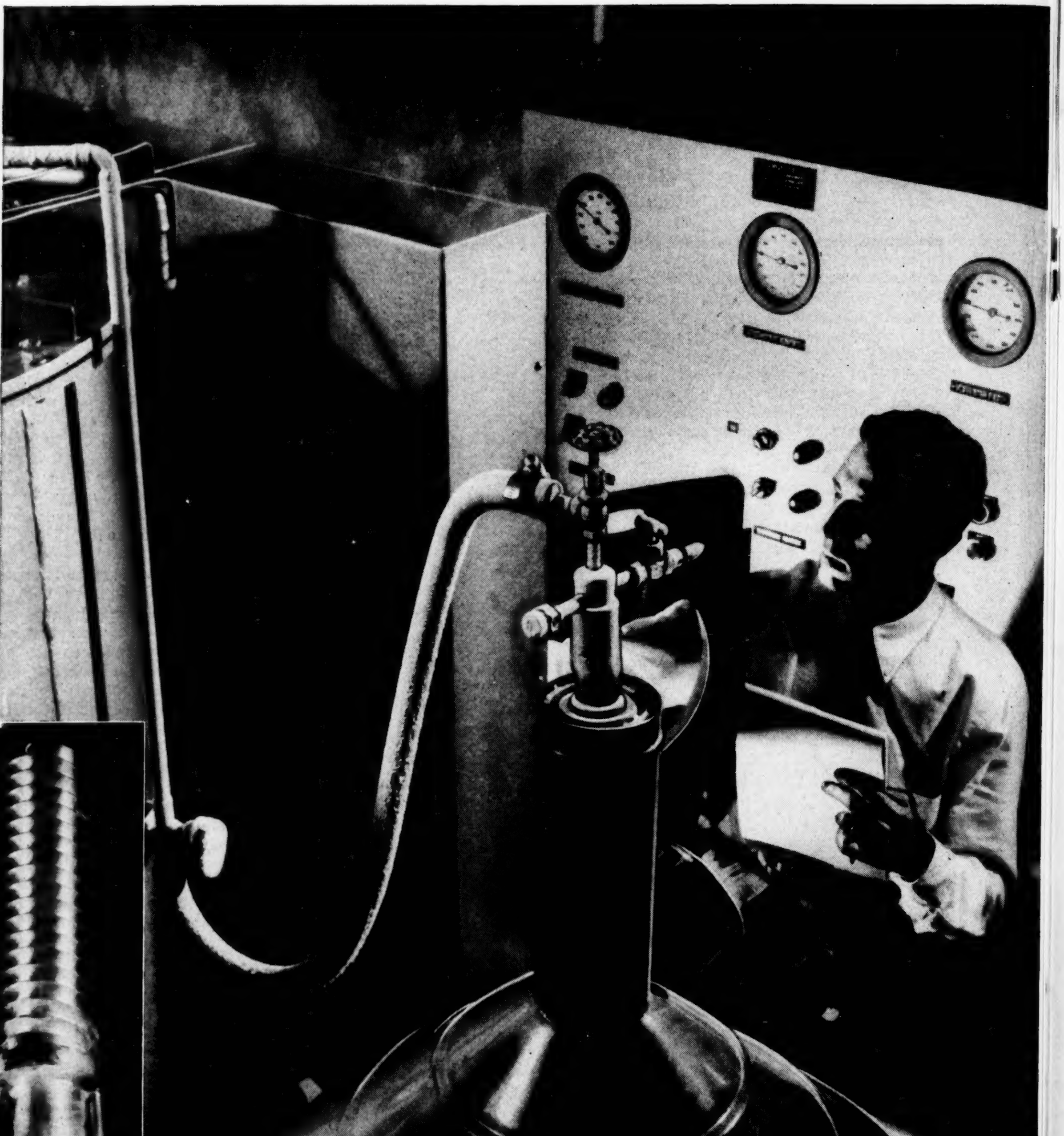
**Soaking Pits**—U. S. Steel Corp.'s Gary Works has placed a contract for the erection of 48 one-way fired soaking pits equipped with the jet pump recuperating systems with Surface Combustion Corp. The installation will consist of 12 four-hole batteries; pits will be 27 ft. long, 9½ ft. wide and 15 ft. deep. Covers will be operated by electronic remote control from crane cabs.

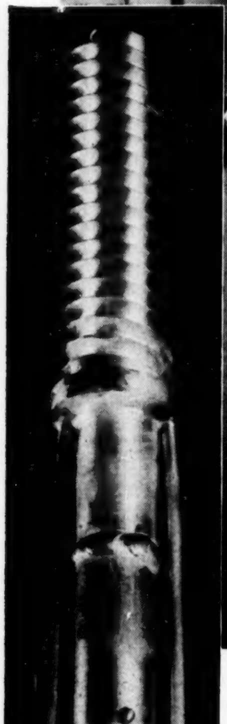
**Enrollment to Increase**—The Census Bureau has estimated that college and university enrollments will skyrocket from 2.8 million in 1955 to 4.9 million in 1965, a 75% increase over the ten-year period. Attendance at Ohio colleges and universities in 1970 is expected to be twice 1955 enrollment.

**Symposium**—A symposium on "Reliability and Quality Control" to be held Jan. 6-8, 1958, at Hotel Statler, Washington, D.C., will cover reliability organization and management, theory and mathematical techniques, application of these techniques, design information, education and training for reliability. Program and information from: Richard M. Jacobs, RCA, Bldg. 108-2, Moorestown, N.J.

**Welding Method**—Lite-Line Metal Industries Division, Copperloy Corp., has announced development of a welding method which permits automatic, continuous welding of magnesium, using the shielded inert arc, consumable electrode process. It employs a small-diameter coiled wire as both filler metal and electrode, has been widely applied to the welding of other metals, but never before been successfully used in the fabrication of magnesium. It is equally applicable to the welding of aluminum.

**Expands Facilities**—Construction of a research and development pilot plant building at the Electrode Division, Great Lakes Carbon Corp., has been started at Niagara Falls, N.Y. Facilities will duplicate every unit operation of carbon and graphite production and will produce newly developed and improved graphite and carbon products on a pilot-plant scale.





Melvin L. Bleiberg, at Bettis Laboratory since 1952, operates the specially designed cooling system for his unique low temperature in-pile cryostat. Mr. Bleiberg is a member of the Solid State Studies Group, which works on fundamental metallurgical projects at Bettis. He received his master's degree in metallurgy from the University of Pittsburgh under the Westinghouse educational assistance program.

Inset shows sample chamber heat exchanger before being enclosed in an aluminum housing. The coolant gas enters the chamber from the aluminum tubing and circulates through the heat exchanger which is a double-pitch, double threaded screw. The test samples are enclosed inside this heat exchanger.

## *Speaks on Effect of Lead on Steel*

*M. J. Bajor, Assistant Supervisor, Bars and Semifinished Products, Quality Control, Inland Steel Co., Spoke on the "Effects of Lead on the Mechanical Properties of Steel" at a Meeting Which Was Held Recently by the Calumet Chapter. Pictured, from left: A. J. Scheid, technical chairman of the meeting; Mr. Bajor; and P. H. Booth, chapter chairman*

Speaker: M. J. Bajor
*Inland Steel Co.*

"The Effects of Lead on the Mechanical Properties of Steel" was the subject of a talk given by M. J. Bajor, assistant supervisor, bars and semifinished products, quality control, Chicago Division, Inland Steel Co., at the annual Past Chairman's Night held by the **Calumet Chapter.**

Mr. Bajor stated that controlled lead additions to various types of steels are effective in improving the machinability ratings. The side effects of this addition on other properties has been a subject of numerous investigations. The speaker reviewed the influence of lead on the mechanical properties of steels. His data were based on published literature and the studies conducted or sponsored by his company.

Comparisons were tabulated between leaded and nonleaded steels of similar compositions. The various tests indicated certain trends which can be summarized as follows:

Strength Levels—The yield and tensile strengths of steel at room temperatures and elevated temperatures are not materially affected by lead additions in either the longitudinal or transverse direction. Some variations in results between leaded and nonleaded specimens have been observed but the magnitude is well within the limits normally encountered within any one grade of steel.

Ductility—Elongation and reduction of area do not appear to be significantly affected by the presence of lead but a trend of slightly lower values was noted, particularly in oil quenched and tempered specimens representing the longitudinal direction. At elevated temperatures, however, a decided decrease occurs, being greatest at approximately 621° F., the melting point of lead.

Impact and Resistance — Impact strength is not adversely affected by the additions of lead, and, when evaluating impact characteristics using a 15 ft-lb. energy level, the leaded specimens exhibit a corresponding lower transition temperature. Below the transition temperature range leaded specimens exhibit higher energy absorption characteristics whereas the reverse trend occurs above the transition temperature range. The magnitude of the difference in both instances is small.

Fatigue—Fatigue properties are not adversely affected by the presence of lead except when the tensile strength of the grade exceeds approximately 130,000 psi. or when the specimen represents an unnotched condition. The significance of this latter condition is that practical engineering design can seldom achieve an unnotched condition.

Other Properties—The limited data for damping characteristics, magnetic and electrical properties and hardenability are somewhat inconclusive but do indicate that no appreciable effect is caused by lead additions to steel.—**Reported by J. W. Luoma for Calumet.**

## Philadelphia Juniors Hear Surface Finishing Talk

Speaker: Edwin Ottens
*Philco Corp.*

An interesting talk on the subject of "Surface Finishing" was presented at a meeting of the **Junior Section** of the **Philadelphia Chapter** by Edwin Ottens, chemical engineer for the Philco Corp. Mr. Ottens presented a picture of the development of protective coatings over the past 30 years, with emphasis on their utility as a base for painting on metallic surfaces.

The two most important protective coatings for metallic surfaces are the chromate and the phosphate types, both of which are conversion coatings with the base metal being converted to the protective compound.

In the chromatic process, an acid solution of sodium dichromate is used to supply chromium ions at the metal interface. Subsequent paint adhesion is improved by the acid coating, because paint oils will tolerate acid but, in the presence of an alkaline atmosphere, will produce a layer of soap on a metallic surface.

While the chromate coating is amorphous and provides a continuous surface protection, the phosphate coating is crystalline and is not inherently corrosion resistant. The prime function of the phosphate-type coating is to act as a good mechanical and chemical base for paint or other rust preventive compounds. The phosphate solutions are so weak in their acidity that a chromic acid rinse is employed as a final step to provide moderate acidity for paint adhesion. Experience has shown that manganese phosphates are best if no paint is to be used on top of the coating.

Because the trend is toward very carefully controlled fine-grained, smooth, dense coatings, the number of coats of paint required to produce a durable attractive product has been greatly reduced. This is possible because the smoother coating is more easily covered and the denser coating requires less paint covering to provide adequate oxidation resistance. By using modern surface finishing techniques, the automobile industry in some instances has been able to cut the number of coats of paint required from ten down to two or three.

Following his discussion, Mr. Ottens conducted a question period in which all present participated.—**Reported by W. L. Hunsberger for Philadelphia Junior Section.**

## *New Films*

**Aluminum Finishing**

A 15-min. color and sound film produced by Turco Products, Inc., demonstrates every aspect of aluminum finishing from pre-cleaning prior to conversion coating to painting and final assembly. Filmed on location during the production of aircraft fuel tanks, this 16-mm. film takes its viewers through the production cycle necessary to paint and complete the tanks. It is available through Turco Products, Inc., 6135 South Central Ave., Los Angeles 1, Calif.

# A.S.M. Review of Current Metal Literature

*An Annotated Survey of Engineering, Scientific and Industrial Journals and Books Here and Abroad Received During the Past Month*

Prepared at the Center for Documentation and Communication Research, Western Reserve University, Cleveland, With the Cooperation of the John Crerar Library, Chicago.

**Annotations carrying the designation (CMA) following the reference are published also in *Crerar Metals Abstracts*.**

## A General Metallurgy

**238-A. Development and Growth of the Australian Steel Industry.** *Engineer,* v. 203, Mar. 29, 1957, p. 501-502.

History of the Australian steel industry and present sources of raw materials. (A11a, A2; ST)

**239-A.** (Finnish.) **Production Prospects of Otanmaki Titanium Ore.** O. Runolinna. *Teknillisen Kemian Aikakauslehti,* v. 14, Mar. 15, 1957, p. 107-110. (CMA)

The ore mined by Otanmaki Co. (Finland) contains 28% ilmenite ($FeTiO_3$), 35% magnetite ($Fe_3O_4$) and 1% pyrite ($FeS_2$), the remainder being silicates. The production, which began in 1953, reached an output of 743,000 tons in 1956. It is composed of iron concentrates and sinter, vanadium pentoxide, iron pyrite, ilmenite concentrate and crushed stone. (A4p, A11a; Ti, 14-9)

**240-A.** (French.) **Some New Applications of Rare-Earth Metals.** Felix Trombe. *Chimie et Industrie,* v. 77, Mar. 1957, p. 540-546. (CMA)

Rare earths promise significant applications in metallurgy, mainly as alloy components and as refining agents. It is the intense chemical affinity of rare earth elements to both metals and nonmetals, combined with the high refractoriness of the compounds so formed, that is the principal source of their valuable metallurgical properties. The study of the alloys has not yet lasted long enough (especially that involving the yttrium group of the rare earths) to permit of definite conclusions of practical applications; the high price of these substances is a handicap. One may mention the high melting point of $PrGa_2$ (1470° C.), of the system praseodymium-gallium with components melting very much lower (gallium melts at 29.5° C.). Considerably more important is the role the rare earths may play as refining agents. A few thousandths by weight added to cast iron causes the precipitation of the spheroidal graphite which characterizes the mechanically superior variety of cast iron. One or two thousandths added to stainless steel insures its perfect forgeability. The life of wires for electric heating (made of Ni-Cr or other alloys) is considerably prolonged when small amounts of rare earth metals are added to the material. The separation of rare earths being too expensive, mixtures of them are used in the operations mentioned above; Lanceramp is composed of lanthanum, cerium, neodymium, praseodymium and samarium and is obtained from electrolytic slimes; misch metal contains mainly lanthanum, cerium and neodymium and is produced directly from monazite.
(A general, 17-7; EG-g, AD-n)

**241-A.** (French.) **Some Generalities on Titanium and Its Metallurgy.** Marcel Fourment. *Société des Ingenieurs Civils de France, Memoires,* v. 110, Jan-Feb. 1957, p. 11-21. (CMA)

A lengthy review of titanium metallurgy surveys its historical development, the current economic situation as regards titanium production, the properties of metal and its alloys (alpha, beta, and alpha-beta), the production of titanium by the reduction of its tetrachloride (Kroll process) and by elecrolytic reduction, various melting methods, and refining of the metal.
(A general; Ti)

**242-A.** (German.) **Titanium, Its Manufacture and Properties.** W. Hess. *Chemische Rundschau,* v. 10, Apr. 1, 1957, p. 141-144. (CMA)

Production statistics, metallurgy and properties of titanium described. Several tables and diagrams illustrate the characteristics of various commercial kinds of titanium produced in Germany by F. Krupp in Essen, and Vereinigte Deutsche Metallwerke in Frankfurt. 37 ref.
(A general; Ti)

*The subject coding at the end of the annotations refers to the revised edition of the ASM-SLA Metallurgical Literature Classification. The revision is currently being completed by the A.S.M. Committee on Literature Classification, and will be published later in the year. A schedule of the principal headings in the revised version was published in the February issue.*

**243-A.** (Portuguese.) **Some Occurrences of Allanitic Ores in Rio Grande do Norte.** R. Agrentiere. *Engenharia, Mineracao e Metallurgia,* v. 25, Mar. 1957, p. 129-132. (CMA)

The author visited several localities in the State of Rio Grande do Norte, in northeastern Brazil (townships of Santa Cruz, Ezequiel and Fernando Pedrosa), which had been reported as bearing minerals of the group of allanite (synonyms: orthite, ceric epidote; constitution: $(Ca, Ce, Th)_2(Al, Fe, Mg)_3Si_3O_2(OH)$). Rock bodies containing these minerals are associated with altered pegmatites of the region. Field examination of the radioactivity of the ores pointed to the existence of uranium as well as thorium. The survey was of a preliminary character. 9 ref.
(A11a; U, Th, 14-9)

**244-A. Ion Exchange in a Modern Nickel-Chromium Plating Plant.** *Electroplating and Metal Finishing,* v. 10, Apr. 1957, p. 116-118.

Operation of ion exchange columns for the recovery of water and copper, nickel and chromium from rinse water of plating plant.
(A8b, L17; Cu, Ni, Cr)

**245-A. Hazards of Beryllium and Its Compounds.** Katherine Williams. *Industrial Chemistry,* v. 33, Apr. 1957, p. 191-193.

Discovery of toxic effects due to beryllium, refers to the characteristics of beryllium poisoning, acute and chronic, and describes preventive control measures. (A7n; Be)

**246-A. Dust Problems of the Iron and Steel Industry—Measures to Stop Atmospheric Pollution.** M. W. Thring and R. J. Sarjant. *Iron and Coal Trades Review,* v. 174, Mar. 29, 1957, p. 731-735.

Problems of dust control in arc furnaces, blast furnaces, coke ovens, reheating furnaces and heat treatment furnaces. (A8a, D general; ST)

**247-A. Heat, Fuel and Power Balances in an Integrated Steelworks.** J. Roberts and J. C. A. Cowan. *Iron and Coal Trades Review,* v. 174, Apr. 5, 1957, p. 781-791.

Integrated iron and steel plants can be made almost independent of outside sources of energy and may be able to sell surplus energy to outside consumers; how over-all energy balance of a new plant was pre-planned. (A5, 16; ST)

**248-A. Concentration of Blast Furnace Flue Dust.** S. B. Das Gupta and P. I. A. Narayanan. *Journal of*

*Scientific and Industrial Research,* v. 16A, Jan. 1957, p. 42-44.

Tabling of the dust after classification provided a satisfactory recovery. The concentrate could probably be fed back into the furnace after sintering. (A8a, D1)

**249-A. Copperbelt of Northern Rhodesia.** Ronald Prain. *Metal Industry,* v. 90, Mar. 29, 1957, p. 245-247.

Development of copper mining industry in Northern Rhodesia and its present and future positions. (A11a; Cu)

**250-A. Prevention of Accidents in Iron and Steel Works.** *Metallurgia,* v. 55, Apr. 1957, p. 171-172.

Notes recommendations of committee of British Iron and Steel Federation on safe coupling of ingot casting cars; operation of straightening machines and prevention of gassing accidents. (A7p, W19e, 1-2; Fe, ST)

**251-A. Tungsten Utilization for High Purity Applications.** Russell C. Nelson. *Mines Magazine,* v. 57, Mar. 1957, p. 68-73.

Refining, alloying, fabrication and use of tungsten by the electronic, electrical and carbide industries. (A general, C general, Ti, 17-7; W-a)

**252-A. Manganese Situation.** Fritz A. McGonigle. *Mines Magazine,* v. 47, Mar. 1957, p. 112-115.

Future of the manganese industry; manganese deposits in U.S.A. and foreign countries. (A4n; Mn, 14-9)

**253-A. Titanium—Today and Tomorrow.** Kim Darby. *Modern Metals,* v. 13, May 1957, p. 84. (CMA)

The growth of the titanium industry in a period of ten years is noted. The industry has a $1 billion potential by 1965 and may eventually reach the current levels of the aluminum and stainless steel industries. Government has a lesser role in the industry than a few years ago. The operations of five sponge producers are described; three other firms will enter the field soon. The trend is toward sodium reduction of titanium but great efforts are being expended to find a cheap electrolytic method. Sponge melting firms, $TiCl_4$ producers, and firms extruding titanium are discussed. (A4, C general; Ti)

**254-A. Uranium Requirements of the Western World.** *South American Mining Engineering Journal,* v. 68, Mar. 8, 1957, p. 423-427.

Development of peacetime uses of thermonuclear reactors indicates that the demand for uranium oxide will expand greatly during the coming years, and that it may be of the order of 100,000 tons a year. (A4p; U)

**255-A. Molybdenum. A Materials Survey.** W. McInnis. *U.S. Bureau of Mines, Information Circular* 7784, Apr. 1957, 77 p. (CMA)

Following a brief historical survey of molybdenum development and production, the geology and resources of numerous molybdenum deposits in the Western United States and in North Carolina are described. Supply of and demand for molybdenum are considered. Mining methods of the Questa (N.M.) and Climax mines and the beneficiation and conversion practices of several firms are discussed. Production, world trade, controls, forms, properties and uses of molybdenum are treated thoroughly. (A4, B general; Mo)

**256-A. New Heating Element Material.** *Metallurgia,* v. 55, May 1957, p. 239-240. (CMA)

Aktiebolaget Kanthal (Sweden) has developed a cermet based on $MoSi_2$ and $SiO_2$ which is hard and brittle and has high bending and tensile strength and low impact strength. Its density increases in the first few hours of operation as a heating element since the sintering process continues. Designated Kanthal-Super, the cermet is intended for use at about 1600° C. Element life depends on furnace conditions, such as surface loading and frequency of temperature change. (A general; SGA-q; 6-20)

**257-A.** (French.) **Future of the Iron and Steel Industry and Industrial Decentralization.** Andre Guedras. *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 303-305.

The discovery of natural gas in the southwest of France and the expansion of the metallurgical industry, which is seeking new sources of ore, will perhaps lead to the erection of new works either at Bayonne or Bordeaux. Factors involved in the selection of an ore-reducing process. (A4n; RM-m, Fe, ST)

**258-A.** (French.) **Symposium on Special Steels at 5th Chemistry Exhibition.** *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 315-326.

Contains the following lectures: M. Dingeon, Chromium and Ferrochromium in Special Steels; Walter Peter, Steels With High Chromium Content; M. Herzog, Aluminum-Chromium Steels. Composition, properties and applications are covered. (A general; ST, *Cr, Al*)

**259-A.** (German.) **Contribution to the Technology of Tin Recovery From Scrap Metals.** H. Anders. *Metall,* v. 11, Apr. 1957, p. 305-306.

Contamination of white metal scrap by iron, zinc and sulphur. Addition of fluxes; smelting in blast furnace. Recovery of the oxides of tin, zinc and lead by Cottrell precipitation. 2 ref. (A11d; Sn, Zn, Pb, RM-p)

**260-A.** (Portuguese.) **Manganese in the State of Amapa.** Joao Gustavo Haenl. *ABM-Noticiario,* v. 11, Mar. 1957, p. 2-5.

Ores discovered in Navio mountain range in 1941 contain 46 to 48% $MnO_2$, have assured market, and, coupled with deposits elsewhere, can make Brazil largest manganese producer in the world. In area explored to date in Amapa are an estimated 30 million tons of commercially usable ore. Industrial development of area to date; future plans. (A11a; Mn, 14-9)

**261-A. Uranium Industry in France.** Maurice Moyal. *Canadian Mining Journal,* v. 78, Mar. 1957, p. 76-79.

Mining districts and the reduction of the pure oxide and extraction of uranium metal in France. (A4n, B general, C general; U)

**262-A. Cerium.** J. Lomas. *Canadian Mining Journal,* v. 78, May 1957, p. 115-116. (CMA)

Cerium, the most important of the lanthanons, may be produced by reducing the trichloride with sodium or by electrolysis of the trichloride in methanol or ethanol and collecting the metal at the cathode as an amalgam. Difficulties in getting the pure metal are mainly technical. The properties of cerium are described. Cerium is amenable to powder metallurgical techniques. Uses include gettering for vacuum tubes, cigarette lighter material, alloying ingredient for aluminum, magnesium and stainless steel, additive for ceramics, arc-stabilizer in carbon arc lamps, and medicine (as the oxalate). (A general; Ce)

**263-A. Niobium's Future Unlimited.** *Chemical and Engineering News,* v. 35, May 27, 1957, p. 25-26.

Present and future use of columbium and columbium alloys. (A general; Cb, 17-7)

**264-A. Metallurgy and the Science of Materials.** Maxwell Gensamer. *Columbia Engineering Quarterly,* Mar. 1957, p. 20-21, 58.

Metallurgy, past and future; significance and application of physical metallurgy. (A general)

**265-A. Britons Give Us a New Aluminum Bronze.** *Design Engineering,* v. 3, Apr. 1957, p. 66-67.

A new high-strength, copper-base alloy having better castability and more attractive mechanical properties than conventional bronzes (Superston 40). (A general, E25p; Cn, *Al*)

**266-A. Spheroidal Graphite Iron.** R. Janardhanam. *Institution of Engineers (India) Journal,* v. 37, Jan. 1957, p. 459-494.

Mechanical properties, service properties and production characteristics of spheroidal graphite iron. Production problems and economics, with particular reference to Indian irons. 10 ref. (A general; CI-r)

**267-A. Safety in Metal Finishing.** Leonard E. Weeg. *Plating,* v. 44, May 1957, p. 510-512.

Safety practices in a plating plant. (A7p, L17)

**268-A. Expanding Need in Nuclear Age for Variety of Metals With Special Properties, Applications.** David D. Moore. *Waste Trade Journal,* v. 103, Mar. 30, 1957, p. 49, 109, 113.

New uses for titanium, zirconium, beryllium, magnesium, nickel, cobalt and molybdenum increase importance of scrap. (A8d, B23; RM-p)

**269-A.** (Czech.) **For Better Production Planning in Metallurgical Works.** Vladimir Smid. *Hutnické Listy,* v. 12, Mar. 1957, p. 243-248.

The functions of the production department in a metallurgical works; principles of planning and scheduling. (A5b)

**270-A.** (French.) **Extraction of Plutonium and Uranium From Nuclear Fuel.** N. Isaac. *Industrie Chimique Belge,* v. 22, no. 2, 1957, p. 139-152.

Two types of extraction processes reviewed: (a) those requiring placement of the solid fuel in solution and therefore taking place in aqueous media; (b) those characterized by use of high temperatures and therefore taking place in absence of water. Advantages and disadvantages of the better known processes; purification systems given in charts. Particular attention drawn to methods of extraction by means of solvents and fractional distillation of fluorinated derivatives. 15 ref. (A11d, C19, T11g, 17-7; U, Pu)

**271-A.** (French.) **Evolution of Low-Alloy Heat Treated Steels in France and Abroad.** Georges Delbart and André Michel. *Société des Ingénieurs Civils de France, Mémoires,* v. 110, Jan-Feb. 1957, p. 22-49.

Rationing of nickel and molybdenum in France during World War II gave rise to search there for substitute low-alloy construction steels. Chemical composition and use of such substitute structural steels as developed in France, Great Britain, Germany and Russia since 1941; welding steels; high strength steels in the U.S.; influence of alloys on mechanical properties of steel. (A11b; AY)

**272-A.** (German.) **Removing the Dust From the Converter Waste-Gases.** Willi Dehne. *Stahl und Eisen,* v. 77, May 2, 1957, p. 553-562.

Dry primary purification; washing-out tests in the chimney; small-scale tests with filters and rotating brushes; coagulation of the dust particles by the sound waves of whistles and sirens; ring-gap scrubbers and electric filters; formation of oxide dust at the converter throat; prevention of the oxide-dust formation by injecting steam through the bottom; dry-cooling by waste-heat boilers. (A8a, D3)

**273-A.** (Italian.) **Mercury From the Almadén Mines.** Francisco Alvarez Ros. *Industria Mineraria,* v. 8, Feb. 1957, p. 77-84.

Richness of deposits at Almadén (Central Spain) and use of modern equipment imported from America permits extraction of 95% and higher of metal contained in ores found there. Hydrargyrism (chronic mercurial poisoning) is not a problem at Almadén now. History of workings since primitive times; strategic and economic importance of these deposits in modern world. (A4n, A7n; B general; Hg)

**274-A.** (Japanese.) **Survey of the Aluminum Industry.** Jiro Kitagawa. *Electrochemical Society of Japan, Journal,* v. 25, Jan. 1957, p. 2-7.

Development of aluminum industry, from statistical point of view. 23 ref. (A4; Al)

**275-A.** (Portuguese.) **Mineral Resources of the Republic of the Sudan.** Hamfrit Putzer. *Engenharia, Mineracao e Metalurgia,* v. 25, Feb. 1957, p. 83-84.

Manganese mines have high-quality ore, but deposits are small; two small iron ore deposits (estimated reserve of 3 million tons of 55-60% Fe) known; large unmined gypsum beds; other poor or unworkable deposits of various kinds described briefly. Concludes that groundwater seems to be most potentially valuable mineral in this arid and semi-arid country. (A4n; Mn, 14-9)

**276-A.** (Portuguese.) **Tantalite and Columbite.** Robert Soliva. *Engenharia, Mineracao e Metalurgia,* v. 25, Feb. 1957, p. 86-88.

Applications and uses of tantalum and columbium, world production and consumption, market data, Brazilian deposits. (A4p; Ta, Cb, 17-7)

**277-A.** (Book.) **Story of Cold Finished Steel Bars.** Fred J. Robbins. 67 p. May 1957. American Steel Warehouse Association, Terminal Tower, Cleveland, Ohio. $1.

Handbook on cold finished steel bars intended mainly for the steel warehousing industry. (A general, F27; ST, 4-5)

**278-A.** (Book.) **Semiconductor Abstracts, v. 3, 1955.** Battelle Memorial Institute, Compiler. 322 p. 1957, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $10.

Third annual volume containing many more abstracts than previous volume (1258), and covering several fringe areas. In addition to the sections on materials, there is one on theory. Author and subject indexes. (A general; SGA-r)

**279-A.** (Book.) **Metal Industry Handbook and Directory 1957.** 536 p. 1957. Iliffe & Sons Ltd., Dorset House, Stamford St., London, England. 15s.

General properties of metals and alloys, electroplating and allied processes, trade names, metal trade associations and directory of buyers. (A general, L general)

**280-A.** (Book—German.) **Handbook for the Metal Trades.** Wilhelm Friedrich. Ed. A. 224 p. 1957. Ferd. Dümmler Verlag, Kaiserstrasse 33/37, Bonn, Germany. DM 5.80.

Contents in tabular form: basic mathematical and physical computations; raw materials and metallurgy; semifinished products; machining and tooling; motors and pyrometry; symbols and drafting aids. (A general, 18)

## B Ore and Raw Material Preparation

**51-B.** **Application of Solvent Extraction in Climax Uranium Company's Plant.** Ralph C. Toerper. *Mines Magazine,* v. 47, Mar. 1957, p. 89-90.

Economical approach to uranium extraction through the application of solvent extraction, a process which will become increasingly more important. (B14; U)

**52-B.** **Today's Era of New Metals and Processes Makes Float-Hydro-Pyro-Chem Metallurgy.** *Mining World,* v. 19, Apr. 15, 1957, p. 34-38.

Review on crushing and grinding, sizing and classification, flotation and ultrasonic methods in the field of extraction and refining. (B13, B14)

**53-B.** **Recovery of Tin and Tungsten From Tin-Smelter Slags.** H. Kenworthy, A. G. Starliper and L. L. Freeman. *U.S. Bureau of Mines, Report of Investigations* 5327, Mar. 1957, 12 p.

Methods that proved effective were fusion reduction, chloride volatilization, sulphide volatilization and carbide formation. (B23; Sn, W, RM-q)

**54-B.** **Strawberry Tungsten Battles Snow, Purchases and Geology.** *Mining World,* v. 19, Apr. 15, 1957, p. 40-43.

Mining, milling and flotation methods for tungsten. (B12, B13, B14h; W)

**55-B.** **New Iron Mills Use Flotation; Research for Reduction Roasting to Magnetite.** Stephen E. Erickson. *Mining World,* v. 19, Apr. 15, 1957, p. 47-51.

Concentration of magnetic and nonmagnetic taconite. (B14h, B15p; Fe)

**56-B.** **Note on a Process for the Extraction of the Rutile Form of Titania From Ilmenite.** A. J. Caskin. *Queensland Government Mining Journal,* v. 58, Jan. 20, 1957, p. 21. (CMA)

Ilmenite may be converted to high-grade rutile by mixing the sand with 20% pyrite and 10% coke, heating in a kiln at 650-900° C. until the reaction is complete, cooling the sintered matter and breaking down with air and water under pressure at 120° C. The sulphur is returned to the pyrite feed and the rutile granules are washed from the iron oxide sludge. Quartz and other contaminants may be removed by conventional ore-dressing methods. $TiO_2$ recovery is about 90%. (B15r; Ti)

**57-B.** **Concentration Tests on the Gold Uranium Ores of the Witwatersrand for the Recovery of Uranium.** J. Levin. *South African Institute of Mining and Metallurgy, Journal,* v. 57, Nov. 1956, p. 209-254.

From most ores 20-30% of the uranium can be recovered by floating the thucholite with a frother only. Subsequent flotation with xanthate increases the uranium recovery by completing the flotation of the thucholite and floating some uraninite; prior cyanidation of the ore is detrimental. An additional recovery of low-grade concentrate can be made by Aerofloat reagents of sulphonates. Maximum recovery of uranium, 70-80% in about 20% weight of concentrate, can be obtained by flotation with oleic acid. 18 ref. (B14h; Au, U)

**58-B.** (German.) **Importance of the Preparation of Home Ores for the West German Iron Industry.** Erich Böhne. *Stahl und Eisen,* v. 77, May 2, 1957, p. 549-552.

Composition of German iron ore; survey of different methods of preparation and concentration; correlations between concentration and yield. (B general; Fe, RM-n)

## C Extraction and Refining

**145-C.** **Mechanism of Titanium Production by Electrolysis of Fused Halide Baths Containing Titanium Salts.** J. G. Wurm, L. Gravel and R. J. A. Potvin. *Electrochemical Society, Journal,* v. 104, May 1957, p. 301-308. (CMA)

Electrolytic titanium from a molten KCl-NaCl bath containing $K_2TiF_6$ and $Na_2TiF_6$ is produced by two steps: reduction of $TiCl_4$ to trivalent double fluorides and reduction of these to titanium metal. The trivalent double fluorides are of the type $K_2NaTiF_6$. Diagrams of the electrolytic cells are shown. (C23p, 1-3; Ti)

**146-C.** **Sodium Process Extracts Titanium in Commercial Tonnages.** J. Milton. *Iron Age,* v. 179, May 9, 1957, p. 120-122. (CMA)

The sodium process for producing titanium granules is employed by Electro Metallurgical Co. (Ashtabula) and General Chemicals Division of ICI (Wilton, England). The problem of the explosiveness of sodium has been overcome and oxygen contamination eliminated. The titanium granules may be mixed with alloying additions in a double cone mixer and then compacted by rotary pellet machines. The block formed serves as a consumable electrode in arc melting. The cast ingots are then dressed to remove blemishes. (C1p, C5h; Ti)

**147-C.** **Controlling Rare-Earth Separations by Means of Varying Resin Column Operating Temperatures.** D.

C. Stewart. *Journal of Inorganic and Nuclear Chemistry,* v. 4, Mar. 1957, p. 131-133. (CMA)

Ion-exchange columns tend to broaden and isolate absorption bands more in the lanthanons later eluted than in those earlier eluted. A "gradient elution" technique has been developed which entails the gradual increase of the pH of the elutriant and a cooling in the 93-25° C. range. Separation time is shortened and the peaks are uniformly spaced. (C19s; EG-g)

**148-C. Electrolytic Refining of Titanium.** R. S. Dean. *Light Metal Age,* v. 15, Apr. 1957, p. 20-22. (CMA)

The titanium electrorefining process of Chicago Development Corp. is discussed. $TiCl_{2-3}$ produced at the anode and alkali metal solution at the cathode react to form titanium particles. The oxygen dissolved in the alloy is converted to $TiO_2$ and remains as an anodic residue. An analytical evaluation of electrolytes showed that NaCl-2.5% $TiCl_{2-3}$ is superior. The reaction equilibria, alloy behavior above the beta transus, anodic behavior versus cathode deposit structure, and preparation of the electrolyte and anode were studied. (C23p; Ti)

**149-C. Melting Metals in Vacuum-Arc Furnaces.** W. J. Kroll. *Metal Treatment and Drop Forging,* v. 24, Apr. 1957, p. 162-168. (CMA)

The vapor pressure-temperature curve of titanium is considered in relation to vacuum-arc melting. Vigorous stirring is necessary to keep the temperature differences in the bath small and to minimize the separation of alloying additions. When degasifying or deoxidizing in vacuo a low dynamic air pressure is necessary to keep the metal from volatilizing. Consumable electrode melting in vacuo is not suitable for degasifying, but an open electrode-arc furnace with two electrodes is satisfactory. The glow discharge phenomenon in vacuum-arc melting is described; it depends mainly on the pressure-voltage function. Problems with degassing titanium sponge and scrap and of hydrogen removal are discussed. A helium-argon shield controls the arc well except with hydrogen-rich sponges.
(C5h, 1-23; Ti)

**150-C. Arc Properties in the Five Rare Gases.** H. S. Morton and R. M. Gage. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 8-18.

Voltage-current and voltage-arc length relationships are presented, calorimetric data are given, and some effects of the self-induced arc jet are discussed.
(C5h, X10, 1-2; EG-m43)

**151-C. Characteristics of Consumable Electrode D. C. Arcs in Argon, Helium and Vacuum.** E. W. Johnson, G. T. Hahn and Robert Itoh. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 19-40.

Arcs were struck in 1 atm. argon between horizontal electrodes of steel, titanium, molybdenum, tungsten and graphite, and also between a molten pool and a vertical cathodic electrode of iron or steel at inert gas pressure between 200 and 0.02 mm. Hg. 4 ref.
(C5h, T1f, 17-7; EG-m43)

**152-C. Effect of Variables on the Melting Rate of Metals in the Consumable Electrode Arc Furnace.** W. H. Smith. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 41-56.

Melting rates of copper, iron, titanium and molybdenum determined as functions of the following variables: kind of metal, crucible to electrode size ratio, power input, melting pressure, and type of electrical circuit. 6 ref.
(C5h, W18s, 1-2; Cu, Fe, Ti, Mo)

**153-C. Effects of Magnetic Stirring on Titanium Ingot Quality.** D. E. Cooper and R. J. Krieger. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 57-68.

Effect of stirring on surface porosity and as-cast grain structure was observed and concluded that optimum degree of magnetic stirring was desirable from the standpoint of ingot quality. (C5; Ti)

**154-C.4 German Developments in the Vacuum Arc Melting of Titanium and Zirconium.** Helmut Gruber. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 118-148.

Control, stabilization problems and safety measures. Furnace producing 1000-lb. ingots of titanium or zirconium at about 40 tons per year was the largest used in the investigations.
(C5h, 1-23, W18s, 1-2; Ti, Zr)

**155-C. Energy Transfer in the High Intensity Arc. Pt. I. A Steady State Treatment of Endothermic Processes Near the Anode Surface. Pt. II. Qualitative Theory of the Anode Sheath.** Marilyn Alder Marquis, Laurence Mead, Samuel Korman and Charles Sheer. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 149-168.

Equations describing matter and energy balance of the anode flame are derived. Effects of variation in power input, anode consumption rate, and ambient pressure on local temperature and matter density of the anode flame are examined and compared with experimental observations. Rapid vaporization of anode material is explained and a tentative explanation given of subsequent superheating of anode vapor. 18 ref. (C5h)

**156-C. The High Intensity Arc in Process Chemistry.** Charles Sheer and Samuel Korman. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 169-183.

Applications to ore reduction in inert atmosphere and vacuum, halogenation and other chemical reactions. Refractory materials, as consumable electrodes, can be vaporized, reacted in homogeneous phase, and condensed, without contacting furnace walls, at power consumption of 4 to 7 kw-hr. per lb.
(C21d, 1-23, W18s, 1-2)

**157-C.** (German.) **Zirconium-Containing Magnesium Alloys With Added Zinc, Cerium and Thorium—Their Preparation and Melting Technique.** Joseph Dornauf. *Zeitschrift für Metallkunde,* v. 28, Mar. 1957, p. 142-145. (CMA)

Zirconium in magnesium alloys has the beneficial property of reducing the grain of the alloy, which increases the mechanical strength of the alloy. However, there is an incompatibility between zirconium and the two important components of magnesium alloys, aluminum and manganese. In the presence of either of these metals zirconium tends to precipitate from the solution in magnesium. It has been found that this can be avoided by substituting zinc, cerium or thorium for aluminum, and that the function of manganese (elimination of iron) is satisfactorily performed by zirconium itself. The author describes the optimum compositions of Mg-Zn-Zr, Mg-Ce-Zn-Zr, Mg-Th-Zr and Mg-Th-Zn-Zr alloys, the mechanical properties of these alloys, and the procedures for their preparation. 8 ref. (C general, Q general, 2-10; Mg, *Zr, Zn, Ce, Th*)

**158-C.** (Russian.) **Mechanism of Reduction of Oxides of Zirconium and Titanium With Calcium Hydride.** G. A. Meerson and O. P. Kolchin. *Atomnaya Energiya,* v. 2, Mar. 1957, p. 253-259. (CMA)

It has been an accepted view that in the reduction of metal oxides with calcium hydride it is the atomic hydrogen, generated through the dissociation of calcium hydride that performs the reduction. Selecting the reduction of zirconium and titanium oxides as appropriate examples, the authors examined the question both a priori and experimentally. Theoretically, they found that the decrease of free energy in the case of calcium reduction is larger than in the case of hydrogen reduction, the difference becoming still larger if the low equilibrium partial pressure of atomic hydrogen at the high temperature involved is taken into consideration. In the direct experimental study of the process comparison was made between the action of calcium hydride and metallic calcium, the latter being used either in the solid state or as a vapor. The reduction with the hydride in the atmosphere of argon was measured, and the process of "self-reduction" of titanium and zirconium hydride by their own hydrogen was examined. It was concluded that calcium plays the essential role in the reduction of oxides with calcium-hydride, that calcium vapors take an active part in the process and that hydrogen dissolved in the metal produced is able to perform a refining action in terminating the reduction of "impurity" oxides. 7 ref. (C26; Zr, Ti, *Ca,* 14-18)

**159-C. Ion Exchange: Five Contributions to Nuclear Technology.** L. D. Roland. *Atomics and Nuclear Energy,* v. 8, Apr. 1957, p. 131-135.

Five applications of the ion exchange method are: (1) uranium extraction, (2) uranium purification, (3) reactor water treatment, (4) zirconium purification, (5) waste disposal. (C19s, A8, W11p, 1-3)

**160-C. Fundamental Research on the Port Pirie Lead Blast Furnace Slags.** W. McA. Manson and E. R. Segnit. *Australasian Institute of Mining and Metallurgy, Proceedings,* v. 180, Dec. 1956, p. 119-147.

Thermodynamics and phase equilibrium relationships of some slag components; mineralogy of some dezinked slags and viscosity measurements. 9 ref.
(C21a, P10f; Pb, RM-q)

**161-C. Continuous Vacuum Dezincing Plant at the B.H.A.S. Pty. Ltd., Port Pirie.** R. Davey and K. C.

Williams. *Australasian Institute of Mining and Metallurgy,* v. 180, Dec. 1956, p. 207-217.

Brief account of the plant which has been developed at Port Pirie to recover, by vacuum distillation, the greater part of zinc content of desilverized lead.
(C22h, 1-23; Zn, Pb)

**162-C. Zone Refining of Impure Copper.** E. D. Tolmie and D. A. Robins. *Institute of Metals, Journal,* v. 85, Jan. 1957, p. 171-176.

Process was applied to an alloy containing 0.01 % antimony, chromium, cobalt, iron, manganese, nickel, silicon, silver and tin. All the added elements segregated in the direction of travel of the molten zone with the exception of iron, cobalt and nickel which segregated in the reverse direction. Experimental results with a mathematical expression were used to calculate effective partition coefficients for the various impurity elements. (C28k; Cu, 9-1)

**163-C. The Development of Iodide Process of Refining Titanium and Zirconium.** R. A. J. Shelton. *Metallurgia,* v. 55, May 1957, p. 225-231. (CMA)

The debt of the iodide processors of titanium and zirconium to workers in the incandescent lamp field is noted. Apparatus used in the van Arkel process for titanium or zirconium of high purity consists of the glass reaction bulb, a molybdenum grid, tungsten filaments and iodine reservoir and a pumping system. A general discussion of work with incandescent filaments is appended. (C1p, 1-2; Ti, Zr)

**164-C. Zone Melting: a Physical Method for Controlling Impurities in Metals.** Douglas H. Polonis. *Trend in Engineering at the University of Washington,* Apr. 1957, p. 23-27.

Principles of zone melting; effect of single and repeated pass zone refining; applications of zone refining. 8 ref. (C28k; 9-1)

**165-C. Electrowinning Chromium Metal.** J. B. Rosenbaum, R. R. Lloyd and C. C. Merrill. *U.S. Bureau of Mines, Report of Investigations* 5322, Mar. 1957, 58 p.

Two separate systems for electrolytic chromium recovery were developed, one designated as the oxidized system and the other as the reduced system. (C23n; Cr)

**166-C. On the Anhydrous Reduced Halides of Zirconium and Hafnium.** E. M. Larsen and J. L. Leddy. University of Wisconsin. Technical Report IX, under Contract N7 onr-2850, *U.S. Office of Technical Services,* PB 124956, Aug. 1955, 22 p. (CMA)

Halogenizing zirconium or hafnium to the trihalide by exposing them to the tetrahalide of the metal was studied with regard to reaction times vs. extent of reaction. Higher temperatures favor trihalide production in the range 200-700° C. Increasing the pressure has a similar effect. Iodides are more easily reduced than the lower halides, the tetrafluoride not being reducibile. Zirconium tetrahalides are slightly more reducible than hafnium tetrahalides. The reaction rate is appreciable only above 450° C. X-ray studies were used. (C19r; Zr, Hf)

**167-C.** (English.) **Extraction of Precious Metals From Production Wastes. Pt. I. Extraction of Metallic Gold From Production Wastes by Synthetic Resins.** A. B. Davankov and V. M. Laufer. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 1037-1039. (Translated by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N.Y.)

Synthetic resins used as adsorbents in the development of a new method for the extraction of metallic gold from industrial effluents. The best results in the extraction of gold in static and dynamic conditions were obtained with the use of highly porous resins. 4 ref.
(C19a; Au)

**168-C.** (English.) **Method of Refining Silicon by Alloying.** Ichiji Obinata and Noboru Komatsu. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 118-130.

For refining crude silicon, a new method consisting essentially of electrolysis of aluminum-silicon anode obtained by alloying crude silicon into molten aluminum is proposed. The principles of the method as well as the results of observations on the behavior of the impurities contained in the crude silicon during the process are described. (C23p; Si)

**169-C. Chemical Treatment of Gold Slime for the Recovery of High Purity Gold and Silver.** G. A. Walker. *Australasian Institute of Mining and Metallurgy, Proceedings,* no. 180, Dec. 1956, p. 21-54.

The ready solubility of gold in dilute aqueous solutions of the cyanides of the alkalis or alkaline earths provides a convenient method for the separation of the precious metal from the large surplus of associated material; treatment of gold slime, dissolution method, chlorination and gold precipitation.
(C19p; Au, Ag)

**170-C. Ammonia Pressure Leach Process Recovers Metals From Ore Concentrate.** *Chemical & Process Engineering,* v. 38, Apr. 1957, p. 159, 160, 164.

An ammonia plant is integrated with the metal recovery plant whereby 75 tons per day of anhydrous ammonia can also be produced, based on natural gas.
(C19n; RM-g31)

**171-C. Now: Uranium Via Solvent Extraction.** *Chemical Engineering,* v. 64, Apr. 1957, p. 149-150.

New process using sulphuric acid leach liquors; experience to date favors extraction over ion exchange.
(C19; U)

**172-C. Preparation of Pure $U_3O_8$ From Crude Sodium Diuranate by Intermediate Complex Formation.** N. S. Krishnaprasad and V. V. Dadape. *Indian Academy of Sciences, Section A, Proceedings,* v. 45, Jan. 1957, p. 20-23.

Separation of uranium from various undesirable elements by solvent extractions and several other complexing procedures; uranium separation from thorium and rare earths. 7 ref. (C19; U, Th)

**173-C. Continuous Casting.** J. Lomas. *Machinery Lloyd,* v. 29, Mar. 1957, p. 95-97.

History, difficulties and advantages of continuous casting.
(C5q, D9q)

**174-C. RIP Recovers $U_3O_8$; Carbonate Leach for Ambrosia; Solvent Extraction Grows.** H. L. Hazen. *Mining World,* v. 19, Apr. 15, 1957, p. 44-46.

Processing of uranium ore by the resin-in-pulp method (RIP); the process recovers dissolved uranium from acid slime pulp by adsorption on anion exchange resin leads.
(C19s; U)

**175-C. Development of the Extraction Process for Uranium From South African Gold Uranium Ores.** A. M. Gaudin, R. Schuhmann and John Dasher. *South African Institute of Mining and Metallurgy, Journal,* v. 57, Dec. 1956, p. 287-304.

Extraction of uranium from pregnant liquor by precipitation and ion exchange resins. The complete process of gold and uranium recovery is shown. 13 ref.
(C19; Au, U)

**176-C. Fission Product Separation From Thorium-Uranium Alloy by Arc-Zone Melting.** R. D. Burch and C. T. Young. Atomics International, *U.S. Atomic Energy Commission,* NAA-SR-1735, Apr. 15, 1957, 23 p.

Investigation to determine the feasibility of removing fission products from irradiated thorium-uranium alloys by using a zone-melting process. This process utilizes an electric arc to maintain the molten zone. Radiochemical analyses of the processed alloys indicated that uranium, tellurium, zirconium and ruthenium were successfully moved in the direction of zone travel, and that some of the fission products were removed during processing by volatilization. (C28k, 2-17; Th, U)

**177-C.** (French.) **On the High-Purity Refining of Uranium by the Zone Melting Process.** Philippe Albert, Omourtague Dimitrov, Jacques Héricy and Georges Chaudron. *Comptes Rendus,* v. 244, Feb. 18, 1957, p. 965-970.

Experiments and highly successful results described. 4 ref.
(C28k; U)

**178-C.** (French.) **On the High-Purity Refining of Iron by the Zone Melting Process.** Jean Talbot, Philippe Albert and Georges Chaudron. *Comptes Rendus,* v. 244, Mar. 18, 1957, p. 1577-1579.

Pure electrolytic iron reveals new properties, particularly aptitude for permitting phenomenon of polygonization. 4 ref. (C28k; Fe)

**179-C.** (French.) **Processing of Uranium Ores.** J. E. Leger. *L'Industrie Chimique,* v. 44, Mar. 1957, p. 67-71.

French uranium deposits; organization of plant, process principles, equipment required to produce uranium products, all with reference to plant built by Ets. Kuhlmann for "Société Industrielle de Minerais de l'Ouest". Role of chemistry in processing of uranium.
(C general, 1-2; U)

**180-C.** (Russian.) **Electrolytic Preparation of the Four-Component Alloys, Nickel - Iron - Molybdenum - Manganese and Nickel-Iron-Molybdenum-Copper.** T. F. Frantsevich-Zabludovskaya and K. B. Kladnitskaya. *Zhurnal Prikladnoi Khimii,* v. 30, Mar. 1957, p. 400-406. (CMA)

Ternary Ni-Fe-Mo alloys obtained electrolytically in previous work can be used for manufacturing metal-ceramic soft magnets. Since it has been observed that the magnetic properties of such alloys are improved by the addition of 0.5% manganese of copper, the authors attempted the preparation of the four-component alloys by the same method of electrolytic coprecipitation, a procedure that has not yet been de-

scribed. They were able to obtain such alloys from ammonium citrate baths and observed that, while the composition of the copper alloy is strictly reducible, that of the manganese alloy suffers considerable variations due to different valencies of molybdenum in the electrolyte. Also while the X-rays of the copper alloy show a single phase of a solid solution, that of the manganese alloy reveals the presence of two phases, an α-Ni solid solution and another unidentified phase. 12 ref. (C27; SGA-n, Ni)

## D Iron and Steelmaking

**144-D. Vacuum Remelting of Superalloys and Steels by the Consumable Electrode Process.** W. W. Dyrkacz, R. S. DeFries and R. K. Pitler. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 97-117.

Electrodes used are air-melted, alloyed cast ingots. Data cover several superalloys, low-alloy, tool and stainless steels. Comparison is made between air-melted and vacuum remelted materials in mechanical properties, gas contents, and cleanliness as determined by inclusion ratings and forged upset tests. 6 ref. (D8m, T1f, 17-7; AY, SS, TS)

**145-D. Deoxidation of Steel by Vacuum Treatment.** *Iron and Coal Trades Review,* v. 174, Mar. 15, 1957, p. 617-619.

Method by which portions of metal are drawn up from the ladle into an evacuated, brick-lined chamber. (D9s, 1-23; ST)

**146-D. Use of Oxygen for Pretreatment of Molten Iron: Small-Scale Experiments Under Acid and Basic Conditions.** J. A. Charles and T. C. Churcher. *Iron and Coal Trades Review,* v. 174, Mar. 22, 1957, p. 667-672.

The pretreatment of molten blast-furnace metal for the removal of silicon by means of the oxygen lance or oxygen jet. The effect of some of the chief variables on the efficiency of the desiliconizing operations and the removal of phosphorus are also considered. (D1h, D11h; Fe)

**147-D.** (Czech.) **What the Theory of Solidification and Crystallization Can Contribute to the Development of Continuous Casting.** Nikolaj Chvorinov. *Hutnické Listy,* v. 12, Mar. 1957, p. 196-201.

Theory of continuous steel casting. On the basis of an analysis of solidification, it would be necessary to determine the cooling zones from the standpoint of conformity with solidification periods. The matter of die cooling consists primarily, according to a theoretical derivation, of the problem of cooling the die itself to obtain absolute homogeneity of temperature and to eliminate heat deformation. This is a basic requirement in respect to surface quality of cast steel as well as die wear. 9 ref. (D9q; ST)

**148-D.** (Czech.) **Effect of Manganese on the Oxidation of Metal and the Velocity of the Desulphurization Process in a Basic Openhearth Furnace.** Vilém Friedrich. *Hutnické Listy,* v. 12, Apr. 1957, p. 324-329.

The effect of high manganese concentration during melting and refining in a basic openhearth furnace upon the metal oxidation in the bath; the velocity of diffusion desulphurization reactions and the formation of inclusions. The increase of manganese content in the bath is of extraordinary importance especially for the attainment of a high notch toughness after aging advantageous for plastic and dynamic properties.
(D11h, D2c; AD-s, ST, *Mn*)

**149-D.** (Pamphlet.) **Chemistry in the Metallurgy of Iron and Steel.** John Chipman. 95 p. 1957. Pennsylvania State University, University Park, Pa. $2.50.

Lectures on physical chemistry of steelmaking; oxidation and reduction in liquid steel, Henry's law in metals, metallurgical slags, hydrogen in steelmaking, and oxygen in the steel industry. (D11)

## E Foundry

**176-E. Pressure Die-Casting: Rapid Production of Carburetor Bodies to Precise Limits.** *Automobile Engineer,* v. 47, Mar. 1957, p. 113-119.

Operations at the Stanmore Engineering Co., Ltd., Stanmore, Middlesex, England. (E13)

**177-E. Needed: Molds for Casting Titanium.** *Chemical and Engineering News,* v. 35, May 20, 1957, p. 84. (CMA)

Battelle metallurgists report that the commercial casting of titanium is not now feasible, but a casting market for 10% of the sponge production is predicted by 1960. What is needed is a cheap, inert mold material. Graphite is expensive and mold life may be low, but maximum depth of contamination is 0.01 in.; penetration may be up to 0.06 in. with refractories of alumina, zirconium dioxide and silica. Companies which have expressed interest in experimental developments are noted. (E11, W19g; Ti)

**178-E. Breakdown of $CO_2$ Cores.** F. LeServe and H. D. Segrove. *Foundry Trade Journal,* v. 102, Apr. 4, 1957, p. 409-411.

Experimental work on the effect of calcium carbonate additions to silicate and sand mixtures for producing cores by carbon dioxide process; demonstrates that 3% calcium carbonate increases ease of breakdown of cores heated to temperatures between 800 and 1000° C. (E21)

**179-E. Hallside Foundry.** *Foundry Trade Journal,* v. 102, Apr. 4, 1957, p. 413-416.

General description of plant layout and techniques employed in molding, casting, stripping and cleaning large castings of low-carbon steel at foundry associated with Steel Co. of Scotland, Ltd.
(E11; CN, 5-10, 18-17)

**180-E. Design of Diecastings and Diecasting Dies. Pt. 4.** W. N. Halliday. *Machinery Lloyd,* v. 29, Mar. 16, 1957, p. 69-74.

Examples of cored holes in diecast components and illustrations of some errors and inappropriate forms commonly specified; coring deep small holes and application of movable cores. (To be continued.) (E13, 71-1)

**181-E. Pressure Die-Castings for Anodizing.** W. H. Hall. *Metal Industry,* v. 90, Mar. 29, 1957, p. 249.

Aluminum alloy requirements for pressure die casting and for production of high-quality anodic finish; conflict between these aims and problem in production of sound bright castings. (E13, L19; Al)

**182-E. Soluble Wax Cores.** C. W. Schwartz. *Modern Castings,* v. 31, Feb. 1957, p. 56-57.

Material for making soluble wax cores consists of a mixture of polyethylene glycol and 160-mesh powdered mica. Problem of shrink voids in cores is overcome by allowing injected pattern wax to enter through small holes drilled in the core to the shrink voids.
(E19g; NM-d 32)

**183-E. Charting the Way to Cupola Quality Control.** Morris Gittleman. *Modern Castings,* v. 31, Feb. 1957, p. 58-60.

A record-keeping program for cupola control as applied at Pacific Cast Iron & Pipe Fitting Co. to aid gray iron quality control. Forms may be modified to fit other foundry operations. (E10a, S12g; CI)

**184-E. Quality and Cost of Magnesium Sand Castings.** Felix M. Giordano. *Product Engineering,* v. 28, Mar. 1957, p. 165-166.

How to avoid common design factors which cause unsoundness or increase the cost of magnesium sand castings. (E11, 17-1, 17-3; Mg)

**185-E. Improve Castings on a Production Basis.** Robert Bargert. *Production,* v. 39, Apr. 1957, p. 80-83.

Problem of determining adequate time and pressure to detect "leakers" can be solved by eliminating porosity; discussion on oxide scaling, design fundamentals, heat control and pump system. (E25q, 17-1)

**186-E. Interim Report on Studies of the Effects of Geometry on the Properties of Gun-Metal (88-8-4) Castings.** W. H. Johnson. Naval Research Laboratory. *U.S. Office of Technical Services,* PB 121769, Jan. 1957, 8 p. $.50.

Study of the tin-bronze alloy gunmetal aimed at establishing the relationship between test-bar properties and properties which may be expected from castings of different geometries and thicknesses; data of interest to the foundryman and design engineer in indicating preferable foundry processing procedures. (E11, Q general, 1-10; Cu, *Sn*)

**187-E.** (German.) **Casting Rejects Due to Shrinkage Cavities.** Hans Reiniger. *Giesserei Praxis,* v. 75, Apr. 10, 1957, p. 129-133.

Causes, types and countermeasures for shrinkage cavities. (E25n, 9)

**188-E.** (Swedish.) **Foundry Mechanization in the United States.** Olof Carlsson. *Gjuteriet,* v. 47, Jan. 1957, p. 1-5.

Various examples of foundry mechanization in the United States principally for the molding department. Importance of a schedule for the different steps of mechanization is pointed out. (E general, 18-24)

**189-E.** (Swedish.) **How to Design Light Metal Castings.** G. Lindh and R. Elg. *Gjuteriet,* v. 47, Feb. 1957, p. 19-23.

Design of gear covers of light metal; sand casting, gravity and pressure die casting. (E11, E13, 17-1; Al)

**190-E. Line Production of Die Castings.** *Engineer,* v. 203, Mar. 22, 1957, p. 453-454.

Particulars of an interesting flow-line system for the manufacture of die castings. Preliminary investigations and how the basic plans were carried out in the works. (E13, 1-2)

**191-E. Properties of Silica With Reference to Foundry Sands.** J. J. Marais. *Engineer and Foundryman,* v. 21, Feb. 1957, p. 50-57.

Comparison of silica with other molding sands. (E18r)

**192-E. Quality Castings in Light Alloy.** P. A. Broadbent. *Inspection Engineer,* v. 20, Nov-Dec. 1956, p. 122-129.

Advantages and disadvantages of casting processes; heat treatment of castings.
(E general, J general; Al Mg)

**193-E. Cost-Cutting With Grinding Wheels: Pt. 1. Snagging Wheel Speed Control.** John A. Mueller. *Modern Castings,* v. 31, Feb. 1957, p. 62-64.

Control of surface speed is first step in planning snagging operations. Relation between wheel speed, wheel work pressure, power consumption and wheel efficiency.
(E24j)

**194-E. Developments in the Casting of Steel Tools for Plastic Moulding.** *Plastics,* v. 22, Mar. 1957, p. 85-88.

Shaw casting process, in which ethyl silical is used as a bonding agent for silica at casting temperature of 1600° C. (E16; TS)

**195-E.** (Czech.) **Production of Pyroferal Castings.** Zdenek Eminger. *Materialovy Sbornik,* 1956, p. 117-140.

Melting, choice of raw materials to be charged, casting technique, shrinkage, sands, molding methods and system of runners and risers. Frequently occurring defects and their cause. Best production methods and advantageous feeding systems for certain kinds of castings.
(E11; SGA-h, Fe, Al, 9-18)

**196-E.** (French.) **Modernization and Partial Conversion of a Foundry.** *Usines d'aujourd'hui,* no. 37, p. 65-70.

Plant of Ets. Bouchayer et Viallet at Grenoble. Efficiency has increased as a result of reducing diversity of products, careful maintenance planning, better handling of space. Problem of quality control largely solved by change to G. S. (spheroidal graphite) type castings and adoption of newly developed Corning precision molding process. (E11, E16c, 18; CI)

**197-E.** (Italian.) **Cost and Technical Comparison of the Various Methods of Producing Commercial Cast Iron.** Hans Malzacher. *Fonderia,* v. 6, April 1957, p. 143-145.

Hot blast cupola, low frequency and industrial frequency arc furnaces compared. (E10, 1-2, 17-3)

## F Primary Mechanical Working

**93-F. Back Extrusion of Heavy-Walled Zircaloy-2 Cups.** J. G. Goodwin and R. W. Tombaugh. *American Society of Mechanical Engineers,* Paper 57-S-15, Apr. 8, 1957, 22 p. (CMA)

The use of vertical and horizontal presses in back-extruding Zircaloy-2 cups was studied. In vertical presses, glass and copper were used as lubricants in back extrusion, and copper was used in impact extrusion. Satisfactory extruding temperatures of billets were 1800, 1600 and 1400° F., respectively. Impact extrusion of bare billets did not give good cups. In a horizontal press, thin copper-jacketed billets and billets coated with "Led-Plate" and $MoS_2$ gave satisfactory cups. Those from the latter billets were slightly inferior and required a 15% increase in extrusion pressure.
(F24b, 1-3; Zr)

**94-F. How Tubemakers Work Zircaloy.** J. S. Rodgers. *Iron Age,* v. 179, May 23, 1957, p. 131-133. (CMA)

Despite the limited reduction per pass due to work hardenability, and despite the gas absorbability, Zircaloy tube production is commonplace. Extrusion practice of Wolverine Tube Co. includes precladding of billets with copper or copper alloy jackets, heating to 1350-1500° F. for 2-4 hr., and extruding in a 3000-ton press under 2500 psi. at a controlled rate. The tube hollow is provided by drilling a hole in the billet, which is also jacketed with copper. When the copper is pickled from the tubing, the latter is further reduced and drawn. A phosphate coat is used as a lubricant. (F24; Zr, 4-10)

**95-F. Department of Defense Titanium-Sheet Rolling Program, Status Report No. 1.** C. R. Simcoe. Battelle Memorial Institute, Titanium Metallurgical Laboratory Report 46A. *U.S. Office of Technical Services,* PB 121624, Mar. 1957. 48 p. (CMA)

The program is divided into three phases: study of process variables in melting and working, collection of design data, and evaluation of titanium sheet in the aircraft industry. (F23, T24, 17-7; Ti, 4-3)

**96-F.** (Portuguese.) **Continuous Cold Rolling of Steel Sheet.** Antonio Doria Machado. *ABM, Boletim da Associacao Brasileira de Metais,* v. 13, Jan. 1957, p. 5-40.

Review of forces that operate during rolling; process of cold rolling and importance of tensions, lubrication and cooling; finish rolling; defects most frequently occurring in hot and cold rolling. 6 ref.
(F23, 1-11, 1-17; ST, 4-3)

**97-F.** (Portuguese.) **Modern Methods of Manufacturing Steel Sheet.** Luiz Antonio de Araujo. *ABM, Boletim da Associacao Brasileira de Metals,* v. 13, Jan. 1957, p. 51-62.

Description of various processes, from manual to modern continuous rolling mills. Comparison of production obtained, space required for installations, capital investment, characteristics of different types of sheet. (F23, W23c, 1-2; ST)

**98-F. Use of a Chip Method to Produce Homogeneous Aluminum-Uranium.** W. L. Larson and J. L. Klein. Nuclear Metals, Inc. *U.S. Atomic Energy Commission,* NMI-1168, Dec. 27, 1956, 65 p.

Each ingot was machined completely into chips, and after being degreased, the chips were thoroughly mixed by tumbling. Chips were then cold compacted, canned, evacuated, hot compacted and hot extruded into a ⅛ x 1⅛-in. flat. The extruded flat was cold rolled to 0.015 ± 0.003 in. thick foil and milled to the proper width. Chemical analyses of the extruded flats and rolled foils showed that homogeneous foils were obtained.
(F general; Al, U, 4-6)

**99-F.** (Italian.) **Stamping of Metals by Means of Hot Plastic Deformation. Pt. II.** Romeo Guisfredi. *Rivista di Meccanica,* no. 154, Feb. 2, 1957, p. 7-8.

Drop forging and free forging as types of hot plastic deformation; applications and equipment; limitations. (To be continued.) (F22, 1-2)

## G Secondary Mechanical Working

Forming and Machining

**199-G. Grinding Titanium.** J. Starr. *Light Metal Age,* v. 15, Apr. 1957, p. 23. (CMA)

Research Associates of Los Angeles grind titanium and its alloys satisfactorily by using grinding wheels, grinding fluids, speeds and feeds which tend to minimize overheating, grinding time and wheel wear. Vitrified bond alumina wheels of 46-303 grain, nitrite-amine rust inhibited fluid, 1500 surface ft. per min. and 400-500 in. per min. table feeds are best. Downfeed and cross feed are 0.001 in. per pass and 0.05 in. (G18; Ti)

**200-G. Properties and Possibilities of Titanium.** *Machinery Lloyd,* v. 29, Apr. 13, 1957, p. 82-86. (CMA)

The effort now being expended in the development of titanium stems from its many valuable properties. Applications in the chemical processing and engineering fields await the fulfillment of the demands of the aircraft industry. ICI Metals Division has studied the machining, grinding, forming and joining of titanium. Tool materials, geometry and rigidity, speeds and feeds are recommended for milling, drilling, planing, shaping, screw-cutting and sawing operations. Forming with hydraulic presses gives good results; the rubber pad method is useful for light-gage parts. Welding processes must be modified to allow for peculiarities in titanium.
(G general, T general, 17-7; Ti)

**201-G. Surface Grinding. Pt. 2. Fundamentals and Methods.** *Grinding and Finishing,* Apr. 1957, p. 37-42.

Grinding conditions such as speed, angle, depth of cut and stress are reviewed. (G18k)

**202-G. Analysis of Metal Cutting Processes.** A. Bhattacharyya. *Institution of Engineers (India) Journal,* v. 37, Jan. 1957, p. 496-509.

Review of investigations on the action of cutting tools in machining operations and the effect of variables associated with it. Mathematical theories described here combined with the practical aspects of the problem give a reasonable opportunity to the machine tool engineer to specify machining conditions for better production. 9 ref. (G17)

**203-G. Titanium Forming; 2.5 Million Lb. of Experience.** *Steel,* v 140, May 20, 1957, p. 178-180, 182, 185, 188, 190, 194. (CMA)

Most of the 2.5 million lb. of titanium used by North American Aviation has gone into the jet engines, afterburner and tailpipe of the F-100 Super Sabre (583 lb. per

aircraft). Current specifications for alloy sheets are given. Surface defects and bend test failures have been trouble spots. The 3% flatness specified is inadequate for some external skin parts. Blanking, shearing, bending, hot forming and pressing, stretching, straightening, deep drawing, heat treatment and cleaning are discussed. Three new alloys, Ti-3Al-6Mo, Ti-4Al-3Mo-1V and Ti-2.5Al-6V, are noted.
(G general; Ti)

**204-G. Forming of Titanium and Titanium Alloys.** W. P. Achbach. Battelle Memorial Institute, Titanium Metallurgical Laboratory, Report 42, Vol. I. *U.S. Office of Technical Services,* PB 121917, May 1956, 247 p. (CMA)

A survey of the airframe industry revealed 13 major forming methods for titanium sheet. The handling of questionnaires and the data therefrom are described.
(G general, T24a, 17-7; Ti, 4-3)

**205-G.** (French.) **Some Fundamental Machining Problems.** E. Bickel. *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 347-353.

Cutting speeds; blunting of tools; consideration of temperature and friction in various operations. (G17)

**206-G.** (Italian.) **Machining by Electro-Erosion.** Nicolas Mironoff and J. Pfau. *Macchine,* v. 12, Mar. 1957, p. 185-193.

New machine tool, *Eleroda DI,* manufactured by Charmilles Co., machines all conductor metals. Principle of electro-erosion machining, work cycle; general description of machine, servomechanism and hydraulic drive; characteristics of, and structural changes in, surfaces machined with this tool; applications. (G24a)

**207-G. How to Grind Boron Carbide.** A. L. Palm. *Industrial Diamond Review,* v. 17, Mar. 1957, p. 54-56.

With the expanding use of boron carbide for gages and other applications requiring high wear resistance, information on the finishing of this material is in increasing demand. General recommendations on selection of wheels, coolants and stock removal rates for various abrading processes. (G18; B, 6-19)

**208-G. Hot Forming, Assembling and Service Applications of Magnesium Alloys.** R. G. Wilkinson. *Institution of Production Engineers, Journal,* v. 36, Apr. 1957, p. 224-237.

Effect of preheating on mechanical properties, preforming operations, surface protection and assembly, design factors. 9 ref.
(G general; Mg, 17-1, 17-7)

**209-G. Contour Etching.** A. W. Sheppard. *Machinery Lloyd,* v. 29, Mar. 30, 1957, p. 70-71.

Brief description of the process; pretreatment, cleaning of material, application of resistance medium, etching and post treatment. (G24b)

**210-G. Face-Milling Titanium Alloy With Carbide Cutters.** W. L. Carr. *Machinery (London),* v. 90, May 10, 1957, p. 1043-1044. (CMA)

Normal milling speeds cannot be used on AMS-4925 titanium alloy with carbide-tipped cutters. Choice of rake angle is important; positive rake weakens the cutting edge and negative rake should be avoided. Speeds in the 85-110 surface ft. per min. range are recommended. Chemical coolants seem to cause chip welding to the carbide tip.
(G17b, 1-2; Ti)

**211-G. Metal Surveys, Machining.** *Pacific Factory,* v. 81, Mar. 1957, p. 34.

Brief review of electrical discharge machining, grinding and ultrasonic machining. (G24)

**212-G. Develop Process for Spinning Titanium.** *Tool Engineer,* v. 38, June 1957, p. 152. (CMA)

Thick titanium hemispheres have been hot spun in production quantities, using a process developed by Titanium Fabricators, Inc. The spinning machine is of the horizontal type with an electrically driven table and is completely hydraulic. The hemispheres of Ti-6Al-4V are welded together to form pressure vessels for gas storage. (G13, 1-2; Ti)

**213-G.** (Czech.) **Rolling of Ball Bearings and Finished Products of Variable Cross Section.** Karel Styblo. *Hutnické Listy,* v. 12, Mar. 1957, p. 227-236.

Modern production technology of balls for antifriction bearings, and the production of parts made until now by drop forging or drop pressing, but which may be manufactured economically by rolling. Rolling methods are dealt with from the technological point of view, as well as from the point of view of the design for production equipment; results of the first experiments with rolling of balls and tapered rollers in Czechoslovakia. (G11, T7d)

**214-G.** (Italian.) **Theoretical Study of the Direction of Flow of Chip During the Machining of Metal Parts.** Salvatore Amari. *Macchine,* v. 12, Apr. 1957, p. 273-279.

Analysis of process of chip formation. Study of machining operations performed with tools having rectilinear cutting edges reveals parameters on which the direction of flow of chip on tool faces depends and the interrelationship of these parameters. (G17)

**215-G.** (Italian.) **Grinding the Ways of Machine Tool Beds.** Pier Lorenzo Levi d'Ancona. *Macchine,* v. 12, Apr. 1957, p. 297-304.

Universal grinder gives better finish at lower cost than can be obtained by scraping operation. Selection of grinding wheels for steel, cast iron and plastic ways; practical hints on technique; inspection of ground ways.
(G18, W25, 17-7; ST, CI, NM-d)

**216-G.** (Italian.) **Precision Grinding and Resistance to Wear.** Pietro Giustina and Gian Federico Micheletti. *Macchine,* v. 12, Apr. 1957, p. 369-377.

Procedures for measuring surface roughness; interdependence of surface roughness and resistance to wear. Surface roughness can be improved by observing close tolerances. (G18, Q9n, S15)

**217-G.** (Italian.) **Stamping of Metals by Means of Hot Plastic Deformation. Pt. I.** Romeo Giusfredi. *Rivista di Meccanica,* no. 153, Jan. 19, 1957, p. 23-24.

Role of hot plastic deformation in manufacturing cycle. (To be continued.) (G3)

**218-G.** (Italian.) **Stamping of Metals by Means of Hot Plastic Deformation. Pt. II, Cont.** Romeo Giusfredi. *Rivista di Meccanica,* no. 156, Mar. 2, 1957, p. 23-25.

Stampings and castings compared with reference to equipment required for production, dimensions and shapes obtainable, chemical composition, grain structure, dimensional tolerances, machinability, physical characteristics in case of carbon steels, probability of rejects in subsequent machining operations, weldability, production costs.
(G3, 17-2)

**219-G.** (Japanese.) **Study on High Speed Machining. Pt. 6. Cutting Speed Effect Based Upon Theory of Tool-Chip Contact Area.** Hidehiko Takeyama and Eiji Usui. *Government Mechanical Journal,* v. 11, Mar. 1957, p. 43-50.

Machining characteristics are improved with the shear angle and with the increase of the chip-thickness ratio. The cutting force decreases for metals with little or no built-up wedge when cutting speed is high. Shear strain in the shear plane has a tendency to be localized into a narrow zone as the cutting speed increases. (G17)

## H Powder Metallurgy

**36-H. Crystal Bar Hafnium Powder, Its Production, Mechanical and Corrosion Properties.** C. T. Waldo and W. K. Anderson. *U.S. Atomic Energy Commission,* KAPL-M-CTW-2, Jan. 10, 1957, 10 p. (CMA)

Hot rolled hafnium powder gives samples with poorer mechanical properties than those from arc-melted and rolled metal. Preliminary corrosion data indicate a superiority over powder metallurgical zirconium. The hydriding process of powder formation is adaptable to large-scale operations. However, the inferior mechanical properties may stem from hydriding.
(H10c, Q general, R general; Hf)

**37-H. Purification of Niobium by Sintering.** W. G. O'Driscoll and G. L. Miller. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 379-384.

Study of columbium's purification by sintering powdered compacts in vacuum. Ductile massive columbium containing 0.05% oxygen, 0.01% nitrogen and carbon and silicon less than 0.01% prepared by high-temperature vacuum sintering on commercial scale. (H15q, 1-23; Cb)

**38-H. Production and Fabrication of Massive Niobium Metal.** L. R. Williams. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 385-392.

Account of melting and powder metallurgical methods for producing ductile columbium from powder. Discusses compacting and sintering processes, including methods of heating, power requirements, vacuum requirements, sintering equipment and techniques, chemical and physical changes; experience in cold forming of sheet, tube, rod and wire and in spot welding and inert-gas arc welding methods. (H14, H15, C5, G general, K1d, K3n; Cb)

**39-H. Metal and Alloy Powders—a Directory.** Herbert B. Michaelson. *Materials and Methods,* v. 45, Apr. 1957, p. 163-169.

Lists production method (or particle shape), approximate mesh size,

purity and name of supplier in comprehensive directory of commercial metal powders.
(H10, H11; 6-18)

**40-H. Powder Metallurgy. Pt. 8. Factors Affecting Growth and Porosity in Sintering.** J. F. C. Morden. *Metal Industry,* v. 90, Apr. 5, 1957, p. 265-268.

Reviews and discusses factors influencing growth, shrinkage and porosity in sintering bronze, brass, copper, tin and iron powder compacts. Factors listed are time, temperature, particle size, shape, plasticity, purity, gas adsorption, compacting pressures, powder stresses, recrystallization, diffusion and furnace atmosphere. (H15; Cu, Sn, Fe)

**41-H. Atmospheres for Sintering Furnaces.** N. K. Koebel. *Metal Progress,* v. 71, May 1957, p. 91-98.

Powder metal compacts consist of such tiny fragments, have such large surface-to-mass ratio that sintering must be done in highly protective atmospheres. These are generated in the same types of equipment as widely installed in modern heat treating departments.
(H15q, 1-2)

**42-H. Preliminary Report on the Manufacture of Gadolinium-Containing Materials by Powder Metallurgy.** H. H. Hausner and N. P. Pinto. *U.S. Atomic Energy Commission,* SEP-64, Apr. 26, 1951. 9 p. (CMA)

In a development program for reactor control rods, various compositions containing gadolinium compounds were studied metallographically prior to operational tests. $GdC_2$ powder was prepared from $Gd_2O_3$. Both were used to the extent of 10% in compacts with beryllium powder. Hot pressing at 600-650° C. and 25 tons per sq. in. yields a dense product with good corrosion resistance to hot water. Compact with titanium powder is contemplated. (H10, H14h, T11j, 17-7; Gd)

**43-H. Extrusion of Composite Compacts of Particles of Heavy Metal in an Aluminum Matrix. Hot Pressing and Extrusion of Zirconium by Electrical Resistance Heating.** A. B. Backensto. *U.S. Atomic Energy Commission,* SO-3004, June 30, 1951. 92 p. (CMA)

Electrical resistance sintering was used to make compacts of zirconium powder in an aluminum matrix. Hot working by extrusion also made suitable compacts, sheaths for the compacts being provided by a pure aluminum powder. A pure zirconium powder could be compacted by electrical sintering if atmospheric contamination is avoided. Ductility is good and cold reduction of 40% may be effected. Billets formed by electrical resistance extrusion are described. (H14k, 16-11; Zr)

**44-H. Ground Zirconium Metal Powder Pilot Plant. Final Technical Report for Apr. 21-Oct. 20, 1952.** A. C. Demos. Foote Mineral Co., under Contracts DA-36-034-ORD-389RD and DA-36-034-ORD-884RD. *U.S. Office of Technical Services,* PB 124145, May 1956. 39 p. (CMA)

A pilot plant with a capacity of 20 lb. of zirconium powder (100 mesh, 10 micron) per 8-hr. day was successfully operated for six days. The process involves the production of a fused sponge through calcium reduction of zirconia tetrachloride, acid leaching, crushing, grinding, drying and packaging. A process flow sheet and experimental data are included. (H10e, C1p; Zr)

**45-H. (French.) Little Known Aspects of the Role Played by Cobalt in the Sintering of Hard Alloys.** René Bernard. *Metallurgie et la Construction Mécanique,* v. 89, Apr. 1957, p. 307-312.

In double carbides with low cobalt content there is an additional phase of which little is so far known. This phase is studied by means of metallographic examination. The influence of decarburization on physical properties is noted, and advice is given to producers and users. 5 ref.
(H15, M27d; Co)

**46-H. Fundamentals of Sintering. Pt. I.** A. Pranatis and L. Seigle. Sylvania Electric Products, Inc. *U.S. Atomic Energy Commission,* SEP-229, Oct. 5, 1956, 20 p.

A study of the mechanism of sintering in pure oxides and metals. In order to ascertain whether the sintering rate of cuprous oxide is controlled by the diffusion of copper ions, the effect of oxygen pressure upon the sintering rate was measured. The sintering rate increased with the oxygen pressure as predicted, but the results were not in quantitative agreement with the Wagner theory. 13 ref.
(H15, 3-24; Cu)

**47-H. Metal and Self-Bonded Silicon Carbide. Pt. 3.** R. E. Wilson. New York State College of Ceramics, Alfred University (Wright Air Department Center), *U.S. Office of Technical Services,* PB 121353, Jan. 1956, 33 p. $1.

Research toward development of a strong, high-temperature silicon carbide through the formation of dense, self-bonded material, and the bonding of silicon carbide by various metals, silicides, carbides and oxides. Aluminum and iron, added in amounts of 1-3%, had a marked effect on the density achieved in hot pressing silicon carbide. Molybdenum silicon carbide compositions were investigated in detail.
(H general; Si, Mo, 6-19)

**48-H. Ceramic Fiber Base Cermets. Pt. 3.** L. J. Trostel. Ohio State University Research (Wright Air Development Center), *U.S. Office of Technical Services,* PB 121354, Mar. 1956, 29 p. $.75.

Feasibility of developing a high-temperature prototype of fiber glass resin plastics investigated; three ceramic fiber-base cermets containing 91% 302B stainless steel and 9% ceramic fibers were fabricated.
(H17; SS)

**49-H. Vibratory Compacting of Metal and Ceramic Powders. Pt. 3.** W. C. Bell and J. R. Hart. North Carolina College (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121255, Mar. 1956, 54 p. $1.50.

Forming, sintering and evaluation of materials for use as turbine blade materials, with primary concern for the influence of particle size distribution on the sintering characteristics and physical properties of alumina, 15% nickel, 85% titanium carbide and 30% chromium, 70% aluminum oxide compositions; application of vibratory, impact and hydrostatic forces in the forming of those compositions from powders.
(H14, H15, T7h, 17-7)

**50-H. (Japanese.) Cermets.** Fumihei Yoshiki. *Japan Society of Mechanical Engineers, Journal,* v. 60, Mar. 1957, p. 267-274.

Physical properties of oxide and carbide-base cermets. 26 ref.
(H general, Q general; 6-20)

## J Heat Treatment

**113-J. Instrumentation of a Continuous Batch-Type Annealing Furnace.** R. H. Gelder and Walter E. Hand. *Instruments and Automation,* v. 30, Apr. 1957, p. 704-707.

A continuous method of annealing steel sheet and plate with improved instrumentation results in one-third higher production with half the Btu. output.
(J23, 1-11, 1-2; ST)

**114-J. Heat Treatment of Aluminum Alloy Forgings.** C. Wilson and J. V. Scanlan. *Light Metals,* v. 20, Mar. 1957, p. 90-94.

Tables of nominal composition and heat treatment conditions of aluminum alloys currently being produced as forgings. Discussion of equipment, temperature control and problems encountered, such as internal stress, overheating, blistering.
(J general, 1-2; Al, 4-1)

**115-J. Heat-Treatment of Magnesium Alloys.** N. Bailey. *Light Metals,* v. 20, Mar. 1957, p. 96-98.

Magnesium alloy and aluminum alloy heat treatment compared.
(J general; Mg)

**116-J. What You Should Known About Carburized Iron Powder Parts.** W. J. Doelker. *Materials and Methods,* v. 45, Apr. 1957, p. 122-126.

Advantages, limitations and effect on properties of gas carburizing, liquid carburizing with salt, pack carburizing or mechanical pre-mixing for iron powder parts of low, medium or high densities. Mechanical properties of a few carburized electrolytic iron powder parts compared to wrought carbon steel.
(J28g, Q general; Fe, 6-22)

**117-J. Hardenability Test for Deep Hardening Steels.** Carl M. Carman, Dominick F. Arminto and Harold Markus. *Metal Progress,* v. 71, May 1957, p. 77-80.

A 1.5 x 11-in. test piece is austenitized uniformly in a tube furnace, then lowered 2 in. and the protruding end cooled with a jet of water while the furnace is being cooled at a rate corresponding to the 3-in. position on the test piece.
(J5, 1-4; AY)

**118-J. Planning for Heat Treating in Malleable Iron Foundries.** J. T. Bryce, L. E. Emery, F. W. Jacobs, L. R. Jenkins, G. B. Mannweiler and W. Zeunik. *Modern Castings,* v. 31, Feb. 1957, p. 39-54.

Summary of metallurgical practices which contribute to the production of white iron and selection of malleable heat treating furnaces, fuels and auxiliary control equipment. (J23b, 1-2; CI-s)

**119-J. (French.) Choice of Gear Steels and Their Heat Treatment.** O. Patterman. *Metallurgie et la Construction Mécanique,* v. 89, Apr. 1957, p. 337-344.

First part of a thorough survey. Characteristics of gear steels; appropriate heat treatments of the various types; nomenclature of Pompey and Roll steels; effect of the mass of work pieces on their characteristics. (To be continued.)
(J general, T7a, 17-7, 3-23; ST)

**120-J.** (French.) **Behavior of Nickel at High Temperatures—Heat and Mechanical Treatments.** *Revue de Nickel,* v. 23, Jan-Feb-Mar. 1957, p. 18-25.

Nickel is sensitive to the action of sulphur and to a somewhat less degree to that of oxygen. Enumerates precautions to be taken, before heating and during heating, to avoid deterioration and contamination of nickel during heat transformations and working.
(J general, N general, 2-12; Ni)

**121-J.** (German.) **Temperature Distribution of and Power Requirements for Inductive Heat Treatment of Circumferential Welds on Steel Tubes.** Herbert Geisel. *Schweissen und Schneiden,* v. 9, Apr. 1957, p. 156-161.

Local temperature variation along the axis of the tube during steady heat conduction; power requirements during the soaking period; heat stored during steady heat conduction; consideration of temperature as a function of heat conduction coefficient, the specific heat and convection coefficient (surface coefficient). 4 ref. (J2g; ST, 7-1, 4-10)

**122-J. Thermal Principles of High-Frequency Inductive Surface Hardening.** Kurt Kegel. *AEG Progress,* no. 3, 1956, p. 193-198.

Fundamental principles involved in the surface heating of steel described in relation to the electrical and thermal processes, and a procedure is derived whereby the approximate depth of hardness to be produced may be estimated. Validity of the procedure discussed, method of determining the temperature variation at the surface described.
(J2g)

**123-J.** (Czech.) **Dependence of Nitrogen Content on the Amount of Carbon in Carbonitrided Cases.** Bohumil Prenosil. *Hutnické Listy,* v. 12, Mar. 1957, p. 222-227.

With increasing carbon content in carbonitrided specimens the amount of nitrogen decreases, this relation being more pronounced at 860 than at 900° C. The knowledge of the mutual relation between carbon and nitrogen content facilitates the attainment of desired carbon and nitrogen content in carbonitrided cases. 17 ref. (J28m)

**124-J.** (Czech.) **Influence of Heat Treatment of Railway Tires on Their Wear.** Slavomir Horejs. *Hutnické Listy,* v. 12, Mar. 1957, p. 277-288.

Through accelerated cooling of tires from the austenitizing temperature, accompanied at the same time by an increase of their hardness, it is possible to increase markedly their wear resistance. For this increase a partial or complete suppression of pro-eutectoid ferrite is decisive.
(J22, Q9n, T23s; ST, 17-7)

**125-J.** (Czech.) **Influence of Nitrogen on the Hardenability of Carbonitrided Cases and on the Isothermal Transformation of Austenite.** Bohumil Prenosil. *Hutnické Listy,* v. 12, Apr. 1957, p. 289-298.

The influence of the amount of nitrogen on the hardenability of carbonitrided cases in using the modified Jominy test; influence of the amount of nitrogen on the S-curve of the isothermal transformation of austenite containing carbon and nitrogen and on the temperature of the beginning of martensitic transformation. 13 ref.
(J5, N8g; ST, *N*)

**126-J.** (Czech.) **Recrystallization and Intermediate Thermal Treatment of Low-Carbon Steels During Cold Working.** Vladimir Vrzal. *Materialovy Sbornik,* 1956, p. 55-76.

On the basis of a general analysis of the physical processes going on within the steel during working, and of experimentally determined spatial diagrams of hardness variation and grain growth during annealing, an intermediate heat treatment is determined. (J23c; CN)

**127-J.** (Czech.) **Nitriding Against Corrosion.** Joseph Zboril. *Materialovy Sbornik,* 1956, p. 79-95.

Considering the high temperatures of the nitriding processes and in view of the necessity of the layer to be rapidly cooled, a special device was designed to be located inside a chamber furnace of the usual type. Various kinds of steel have been nitrided and the results verified by practical tests. 9 ref.
(T28k, 1-2; ST)

**128-J.** (German.) **Present State of Flame Hardening.** G. W. Grönegress. *Metalloberfläche,* v. 11, Jan. 1957, p. 7-11.

Flame hardening becomes more economical as the surface to be hardened becomes a smaller part of the over-all surface and with larger dimensions of the workpiece. Application of temperature measuring instrument "milliskop" to secure evenness of hardening. Advantages of hardening machines.
(J2h)

**129-J.** (Italian.) **For a Greater Popularity of the Jominy Hardenability Test.** M. Baj. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 186-194, 211.

Examination is made of operating conditions of the Jominy test which is one of easy execution and fair reproducibility. The technical and economic aspects of the test are emphasized. It is a test intended to help producers and consumers of steel when selecting alloying elements and conditions for the best heat treatment. 48 ref.
(J5, 1-4; ST)

**130-J.** (Italian.) **Surface Decarburization During Salt Bath Heat Treatment.** Armando Andreotti. *Rivista di Meccanica,* no. 153, Jan. 19, 1957, p. 27-31.

Causes of decarburization of ferrous metals; methods of controlling decarburizing power of the bath; corrective measures designed to eliminate or reduce decarburizing power. (J4a, J2j; ST)

## K Assembling and Joining

**235-K.** (Italian.) **Comparative Study of Welding Practices in Europe. Notes on O. E. E. C. Mission-EPA 250 (4-15-55, 5-16-55).** Antonio Lo Giudice. *Ingegneria Meccanica,* v. 5, Dec. 1956, p. 43-46; v. 6, Jan. 1957, p. 33-39.

Pt. 1. Major industrial plants of Western Europe in which welding is of special importance were visited. This report, edited by a delegate of the Italian government, is intended to give a picture of welding methods, preparation practices; types of steel welded, design standards, consumption of steel and electrodes, etc., in countries visited. Pt. 2. Practices and equipment in English, Norwegian, Swedish, Danish, Dutch plants. (To be continued.)
(K general)

**236-K. Condenser Tubes Are Welded.** R. A. Wilson and W. W. Edens. *Electrical World,* v. 147, Apr. 22, 1957, p. 57-58.

Tungsten inert gas welding was found to be best, especially when an over-riding high-frequency arc current initiates the arc and starts the weld. Naval brass tube sheets and admiralty metal tubes are joined.
(K1d; Cu, 4-10)

**237-K. Welding of Steam and Feed Pipework for Marine Installations.** J. Chamberlain and W. L. Roe. *Welding Research Abroad,* v. 3, Mar. 1957, p. 29-38.

Suitability of certain types of steel for specific steam temperature ranges; types of welded joints and preparation of tubes for welding; filler rods and electrodes; preheating; post-welding heat treatment; nondestructive examination; repairs to faulty welds. 8 ref.
(K general, T22, 17-7; ST, 4-10)

**238-K.** (French.) **Contribution to the Study of the Control of the Voltage, Strain, Time Parameters in Resistance Spot Welding.** M. Evrard and C. Haslé *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 69-75.

Method based essentially on the use of a stylus-type oscillograph, the measuring gear of which is connected to various devices for the determination of the welding parameters. The simultaneous recording and direct examination of the curves obtained permit an efficient control of the spot welding operation.
(K3n, 1-2)

**239-K.** (French.) **Welded Framework of the Boulogne-Billancourt Skating-Rink.** P. Lorin. *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 76-81.

Details of design and construction. The whole structure contains 3800 m. of electrically welded beads for which basic coated electrodes were used. (K1a, T26n, 17-7; ST)

**240-K.** (French.) **Use of Superficial Colorations Produced by Hot Oxidation as a Nondestructive Testing Method in Spot Welding.** P. Joumat. *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 93-99.

Method used for ascertaining the efficiency of heat treatments under electrode tips without destroying the spot welds. Emphasizes the relationship between colorations, hardness and torsional characteristics of spot welds and notes the effect of metal analysis and several welding and dispersion factors. In its present form the method facilitates setting operations and makes it possible to check setting adequacy in the course of industrial fabrication. (K3n, K9r)

**241-K.** (French.) **Productivity of Brazing.** G.M.A. Blanc and J. C. Charton. *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 111-118.

Influence of modern brazing pro-

cedures on cost and productivity. The total cost of an assembly can be reduced by using a high-quality filler metal, notwithstanding its higher unit price. Various examples of application of oxy-acetylene, gas flame, oven and high-frequency brazing are given. Emphasizes the great versatility of brazing. (K8; SGA-f)

**242-K.** (German.) **Maintenance and Repair of Parts and Components by Means of Welding. Pt. I.** Herbert Neumann. *Schweissen und Schneiden,* v. 9, Apr. 1957, p. 138-146.

Welding of joints for locomotive and ship boilers, drive and brake components, wheels, couplings, pipes and castings; application of various types of electrodes; flash-butt welding; automatic welding.
(K general, 18-21, 18-22)

**243-K.** (German.) **Automatic Carbon-Dioxide Shielded Arc Welding With Slag Covering.** C. de Rop and H. Schmidt-Bach. *Schweissen und Schneiden,* v. 9, Apr. 1957, p. 146-150.

Working principle of the automatic welding machine; welding operation; design of the Falz electrode; mechanical properties of the weld metal; melting rates. 4 ref. (K1d, 1-2)

**244-K.** (German.) **Acceptance Rules for Chains Made From Round Steel Bar Material.** Rudolph Overlach. *Schweissen und Schneiden,* v. 9, Apr. 1957, p. 150-155.

Anchor chains for ships; chains for mining, hoists, scaffolding, structural engineering purposes; foreign standards for chains; present position of acceptance rules for chains with regard to welding.
(K9r, T7e, 17-7; ST)

**245-K.** (Italian.) **Arc Welding in Atomic Hydrogen Atmosphere.** Lelio Orsini. *Macchine,* v. 11, Mar. 1957, p. 257-259.

Equipment, technique, advantages, applications. (K1d, 1-2)

**246-K. Inert Gas Shielded Welding of Aluminum Bronze.** P. C. Greene. *Bureau of Ships, Journal,* v. 5, Apr. 1957, p. 11-12.

Advantages and disadvantages of non-nickel-bearing wrought aluminum bronze plate; spectrographic method of detecting cracks caused by welding. (K1d, S13d; Cu, *Al*)

**247-K. Ultrasonic Metal Joining.** J. Byron Jones and E. E. Weismantel. *Electrical Manufacturing,* v. 59, Apr. 1957, p. 125-129, 316.

Ultrasonic energy is being used in soldering, brazing and welding. These processes are particularly applicable to specialized joining problems in electrical design. Improved joint reliability is achieved through elimination of flux, and cost savings can be effected by substituting aluminum for copper in electrical assemblies. (K6, K7h, K8, 1-24)

**248-K. Testing of Welding Metal With Special Reference to the Control of South African Bureau of Standards Approved Electrodes.** J. W. Swardt. *Engineer and Foundryman,* v. 21, Feb. 1957, p. 41-45.

Brief comment on impact resistance tests, usability tests and interpretation of radiographs. (K9r)

**249-K. Welding Distortion Problems Encountered in the Gas Turbine Industry.** S. A. Onions. *Institution of Production Engineers, Journal,* v. 36, Mar. 1957, p. 193-199.

Causes of weld distortion and the economic and technical difficulties involved in its correction. (K9n)

**250-K. How to Solder Stainless Steel.** *Marine Engineering Log,* v. 62, May 1957, p. 70-71.

Preparation of surface, selection of solder and finishing of stainless steel soldered joints. (K7; SS)

**251-K. Canada to Get New Welding Process.** *Modern Power and Engineering,* v. 51, Mar. 1957, p. 120-121.

A new process for the welding of carbon steel; semi-automatic metal arc welding process, using a continuously fed bare wire, powdered magnetic flux, and carbon dioxide gas. (K1d; CN)

**252-K. Welding Processes Described.** *Oil and Gas Journal,* v. 55, Apr. 8, 1957, p. 129-132.

Application of submerged arc, inert arc and resistance welding. 3 ref. (K1d, K1e, K3)

**253-K. Remote Welding of Stainless Steel Containers.** E. E. Pierce. Oak Ridge National Laboratory, *U.S. Atomic Energy Commission,* ORNL-2280, Apr. 22, 1957, 8 p.

Equipment for sealing stainless steel cylinders containing radioactive materials by remotely operated shielded-arc welding has been fabricated and successfully operated. The equipment consists of two portable units. One of the units, including a rotating chuck and electrode positioner, is operated in a cell equipped with model-8 master-slave manipulators. The power supply unit and control panel are of conventional design and are operated outside the cell.
(K1d, W12a, 1-2; SS)

**254-K.** (Italian.) **Comparative Study of Welding Practices in Europe. Notes on O.E.E.C. Mission EPA 250 (4-15-55, 5-16-55). Pt. III.** Antonino Lo Giudice. *Ingegneria Meccanica,* v. 6, Feb. 1957, p. 17-24.

Practices and equipment in German, Belgian, Austrian and Swiss plants. (To be continued.)
(K general)

**255-K.** (Italian.) **Welded Structures. Criteria and Standards of Design and Execution.** G. P. Perego. *Rivista di Meccanica,* no. 155, Feb. 16, 1957, p. 19-24.

Welded joints; types of joints and placement of welds; oxy-acetylene and electric arc welding procedures. (To be continued.)
(K1, K2, S22, 17-1)

**256-K.** (Pamphlet—German.) **Qualitative Examination of Spot Welded Joints on Deep Drawn Aluminum Sheets, Produced With the Argon-Shielded-Arc Spot Welding Method.** K. Krekeler and H. Verhoeven. Forschungsberichte des Wirtschafts-und Verkehrsministeriums Nordrhein-Westfalen, no. 275, 1956, 52 p. Westdeutscher Verlag, Ophovener Strasse 1-3 Opladen, West Germany. DM 14-60.

Starting materials, influence of various factors during the process, practical applications, metallographic examination. 7 ref. (K3n; Al, 4-3)

## L Cleaning Coating and Finishing

**262-L. Low Temperature Descaling Safeguards Titanium Properties.** I. Stambler. *Aviation Age,* v. 27, May 1957, p. 130-133. (CMA)

Turco Products (Los Angeles) has developed a low-temperature descaling method which gives chemical cleanness, low hydrogen pick-up, low metal loss, passive surface activity, intergranular attack and improved smoothness. After precleaning, the parts are alkaline-cleaned in Turco 4272 scale remover and in Vitro-Klene or Petro-Klene, rinsed, and acid-cleaned in $HNO_3$. (L12, 2-13; Ti)

**263-L. Electrolysis Cleans Titanium.** *Aviation Week,* v. 66, May 13, 1957, p. 79, 81. (CMA)

Temco Aircraft (Dallas) uses the "Ti-Brite" electrolytic process to descale and degrease titanium aircraft parts. Surface qualities are improved and there is no etching effect. The immersion bath contains 1% of 48-70% HF, 4% of 38-46° Bé $HNO_3$, 20% of 60-66° Bé $H_2SO_4$ and 75% water; 3-5 oz. of ferrous or aluminum sulphate are also present. The d.c. voltage is 6-36 volts. After immersion for 1-3 min. the polarity is reversed. The part is then removed and wiped clean.
(L13n; Ti)

**264-L. Protective Coating of Titanium.** C. L. Stanley and A. Brenner. *Light Metal Age,* v. 15, Apr. 1957, p. 27-28. (CMA)

A protective coat of chromium may be plated on a titanium surface if the oxide film is supplanted with a fluoride film before plating. After 10-15 min. of suspension in hydrofluoric-acetic acid bath and 10 min. of 60-cycle a.c., the specimens are rinsed and removed to a typical chromium plating bath where they are plated at 85° C. and 120 amp. per sq. dm. They are then heat treated at 800° C. for 2 min. in inert atmosphere. Adhesion of the plates is good. (L17; Ti, *Cr*)

**265-L. Anodic Oxidation of Some Dilute Binary Zirconium Alloys.** G. B. Adams, Jr., C. E. Borchers and P. Van Rysselberghe. *U.S. Atomic Energy Commission,* AECU-3388, Jan. 1, 1957, 26 p. (CMA)

The anodization of zirconium alloy electrodes was performed in a cell, which is described and the circuitry of which is diagrammed. Potential-time data for alloys with columbium, nickel, iron, copper, tin and chromium (to a total of nine) were obtained for three current densities. Electrolytic parameters and local currents were calculated. 4 ref.
(L19, 1-2; Zr, *Cb, Ni, Fe, Cu, Sn, Cr*)

**266-L.** (German.) **Protection of Molybdenum Against Oxidation at High Temperature.** Karl Wassmann. *Verin deutscher Ingenieure, Zeitschrift,* v. 99, Apr. 1, 1957, p. 423-425. (CMA)

Problem of protecting molybdenum surfaces against oxidation at elevated temperatures is discussed. No molybdenum alloy has been found that would correct the inability of molybdenum to form a protective oxide film. It is therefore necessary to resort to coatings which may be either inert themselves (like ceramics or certain metals) or oxidizable into an inert protective layer. Such coatings can be applied by spraying. The best experimental results have been obtained with chromium, chromium-nickel and aluminum-chromium-silicon, giving protection up to 1100° C., and with molybdenum sulphide for temperatures above 1300° C. (L23; Mo)

**267-L. Painting of Steel Structures in Petroleum Refineries.** J. O. Jackson and Joseph Bigos. *American*

*Petroleum Institute, Proceedings,* v. 36 (III), 1956, p. 34-48.

Proper design and surface preparation, correct application, selection and formulations of paint for structural steel to prevent corrosion. (L26n; ST, SGA-s)

**268-L. Finishing Polished Metal Parts for Rembrandt Lamps.** Edward Ciebien. *Industrial Finishing,* v. 33, Apr. 1957, p. 48-52.

Procedure and precautions in buffing, degreasing and lacquering metal lamp parts. (L10a, L12, L26n)

**269-L. Epoxy Coatings for Metal Products.** R. E. Dunbar. *Materials and Methods,* v. 45, Apr. 1957, p. 130-134.

Composition, properties, methods of application and typical uses of the six main types of formulations. Coatings are noted for excellent adhesion, flexibility, toughness and chemical resistance. (L26p)

**270-L. Plating With Insoluble Anodes.** Edward R. Jorczyk. *Metal Finishing,* v. 55, Mar. 1957, p. 46-49.

With the use of insoluble anodes, installation of a silver concentration tank eliminated solution decomposition, maintained an even silver content of solution and kept carbon treatments to a minimum. (L17, W3h, 1-2)

**271-L. Finishing Nickel and High Nickel Alloys.** Lester F. Spencer. *Metal Finishing,* v. 55, Mar. 1957, p. 50-55; disc., p. 61.

Operational procedures for finishing wrought nickel, Monel and Inconel. Details as to wheel type, wheel speeds and specific examples of finishing are discussed. (L general, G18; Ni)

**272-L. Bright Nickel Plating.** I. R. Bellobono. *Metal Finishing Journal,* v. 3, Mar. 1957, p. 111-117; disc., p. 127.

Coordination compounds and the plating potentials of metals in relation to the theories propounded to account for bright nickel plating. 27 ref. (L17; *Ni*)

**273-L. Anodising and Brightening of Aluminium and Its Alloys.** A. W. Brace. *Metallurgia,* v. 55, Apr. 1957, p. 173-185.

Composition and operating conditions of main electro brightening, electropolishing and chemical brightening and anodizing processes; their merits and limitations, influence of composition and effect of metallurgical structure in response to brightening and anodizing. 27 ref. (L13, L19; Al)

**274-L. Plating Steel With Molybdenum.** *Steel,* v. 140, May 20, 1957, p. 161, 164. (CMA)

A successful vapor-plating experiment is described which involved surfaces of AISI 4620 steel and $MoCl_5$ vapor. Thin underplatings of cobalt were used and were better than those of copper and nickel. The surface is heated to 1607-1787° F. The $MoCl_5$ vaporizer operates at about 482° F. and discharges an argon stream saturated with $MoCl_5$ vapor which is reduced by a stream of hydrogen in a burner near the plate. Hydrogen-rich mixtures give dense, well-bonded plates which are heat and erosion-resistant. (L25; ST, *Mo*)

**275-L.** (English.) **Cleaning of Aluminum Articles by Alkaline Solutions and Works Control of This Operation.** M. N. Rozov and T. A. Trainina. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 975-983. (Translated by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N.Y.)

Deals with kinetics of the process. (L12k; Al)

**276-L.** (English.) **Investigation of the Anode Process in the Aluminum Bath.** L. N. Antipin and A. N. Khudyakov. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 985-990. (Translated by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N.Y.)

Detailed study has been made of the relationship between the anode gas composition and the polarization on the one hand and the current density on the other. (L19; Al)

**277-L. It Is Cheaper by Tumbling.** Leon E. Laux. *Metal Finishing Journal,* v. 3, Feb. 1957, p. 67-70.

Operational costs of barrel finishing by the Glenn L. Martin Co. About 95% of parts tumbled are aluminum alloys. (L10d; Al)

**278-L. Continuous Electrolytic Oxidation of Aluminum Wire and Strip.** H. Richaud. *Metal Finishing Journal,* v. 3, Feb. 1957, p. 71-74.

Two continuous methods are described; oxidation for electrical insulation and oxidation for decorative purposes. (L19; Al, 4-3, 4-11)

**279-L. Suitability of Fusion-Welding Processes for Vitreous-Enamelling.** B. Trehearne. *Metal Finishing Journal,* v. 3, Feb. 1957, p. 79-82.

Some of the factors influencing quality of vitreous enamel on fusion-welded sheet metal are considered. Four methods of fusion welding and the results of experiments are discussed. Relationship between weld defects and enameling defects was established by X-ray examination. (L27, K general; 9)

**280-L. Feasibility of Roll Cladding Titanium on Steel. Summary Report for Nov. 1, 1955 to Dec. 31, 1956.** R. F. Domagala and D. W. Levinson. *U.S. Atomic Energy Commisssion,* AECU-3431, Dec. 31, 1956, 71 p. (CMA)

Titanium may be roll clad onto plain carbon steel if a diffusion barrier of vanadium is interposed between the metals. These "sandwiches" are hot rolled to sheet at 850-1000° C. Bend and shear strengths of the sheet are great, and anneals at 750° C. for 1000 hr. do not affect the quality. A vanadium-iron phase, probably sigma, is observed at the interface unless a thin layer of copper is placed between the vanadium and steel. Similarly clad stainless steel was satisfactory. (L22; ST, *Ti, V*)

**281-L. Metal Spraying in Inert Atmospheres.** R. E. Monroe, O. C. Martin and C. B. Voldrich. *U.S. Atomic Energy Commission,* BMI-994, Dec. 17, 1953, 21 p. (CMA)

Metal-arc spraying of zirconium coats on uranium was studied. The defects of the as-sprayed coat—porosity and unflattened spray particles—were overcome by a diffusion heat treatment. An arc between two consumable electrodes is fed through a high-velocity gas blast and an inert atmosphere is used. The method has been abandoned since other methods have been studied. (L23; U, *Zr,* 9-18)

**282-L. Development of a Cubic Oxide Protective Film on Zirconium.** J. R. Johnson. *U.S. Atomic Energy Commission,* ORNL-2029, Feb. 21, 1955, 7 p. (CMA)

The more stable (to neutrons) cubic form of $ZrO_2$ may be developed in preference to the monoclinic form by alloying zirconium with a metal which forms a cubic oxide. Columbium is the most promising and is amenable to forging and processing. The metal chosen must form a cubic phase in other corrosion environments, form an oxide at low temperatures and, as the oxide, have a stable cubic form. (L14a, M26r; Zr, *Cb*)

**283-L. Influence of Heat Treatment on the Properties of Chemical Nickel Coatings Produced by the Kanigen Process.** Van Royen. *Electroplating and Metal Finishing,* v. 10, Apr. 1957, p. 114-115.

Structure of chemical nickel deposits produced by the nickel phosphorus process and the effect of various heat treatments on their corrosion resistance and mechanical properties. (L28, M27, Q general, R general, 2-14; *Ni*)

**284-L.** (French.) **Electrolytic Galvanizing of Steel Sheets.** F. H. Smith. *Corrosion et Anticorrosion,* v. 5, Jan. 1957, p. 10-18.

Characteristics and advantages of this process; corrosion resistance compared with other coatings; techniques used in England and the United States; applications, including aptitude for machining and welding. (L16; ST, *Zn,* 4-3)

**285-L.** (French.) **Surface Treatment Before Painting or Temporary Coating of Such Metals as Steel, Aluminum, Zinc.** C. Hess. *Corrosion et Anticorrosion,* v. 5, Jan. 1957, p. 19-24.

Chemistry of surface treatments, and types of coating and protection afforded. (L general; ST, Al, Zn)

**286-L.** (French.) **Protection of Motor Truck Tankers by Means of Neoprene Base Coatings.** G. de Laberbis. *Corrosion et Anticorrosion,* v. 5, Jan. 1957, p. 25-26.

Applicable either in sheet or liquid form, neoprene affords excellent protection against concentrated caustic soda in tank trucks. Cites successful use of this product in the United States. (L26r R6j)

**287-L.** (French.) **Treatment of Surfaces for Galvanizing: Pickling.** A. Herz. *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 355-357.

Pickling in sulphuric acid; effects of strength of concentration and temperature; pickling by hydrochloric acid; pickling of cast iron. (L12g; L16; *Zn*)

**288-L.** (German.) **Galvanizing of Screws and Other Small Parts. Pt. IV.** Werner Peters. *Draht,* v. 8, Apr. 1957, p. 127-131.

Quality control, including thickness of the layer, corrosion resistance and gage accuracy are discussed, as well as calculations given for the complete galvanizing process. 3 ref. (L16, T7f, 17-7; *Zn*)

**289-L.** (German.) **Chemical and Electrochemical Treatment of Corrosion Resistance Steels.** O. P. Krämer. *Metallwaren-Industrie und Galvanotechnik,* v. 48, Apr. 1957, p. 148-152.

Details of pickling, electrolytic pickling, protective coating, burnishing and coloring. (L general; ST, SGA-g)

**290-L.** (German.) **Ball Polishing.** M. Dreher. *Metallwaren-Industrie und Galvanotechnik,* v. 48, Apr. 1957, p. 160-164.

Choice of suitable metals, surface characteristics and shape, preparatory treatment, time necessary for polishing and applications of methods. (L10d)

**291-L. Highly-Conducting Gold Films Prepared by Vacuum Evaporation.** A. E. Ennos. *British Journal of Applied Physics,* v. 8, Mar. 1957, p. 113-117.

Thin gold films formed by vacuum evaporation on freshly evaporated layers of certain metallic oxides show high conductivity in a similar way to layers prepared by cathodic sputtering. The evaporated layers are robust and of high current-carrying capacity down to 30-Angstrom thickness. The conductivity approaches the bulk value for annealed films thicker than 60 Angstroms. Properties of these films discussed in relation to those of the sputtered layers, with which they compare favorably. 9 ref. (L25g; Au)

**292-L. Dyeing of Anodised Aluminium.** B. L. Sen. *Indian Textile Journal,* v. 67, Jan. 1957, p. 236.

Aluminum in its pure form can conveniently be employed for dyeing with synthetic dyestuffs; brief procedure is presented. (L19; Al)

**293-L. Surface Treatment and Finishing of Light Metals. Pt. XII-C. Plating on Aluminum-Zinc Immersion Processes.** S. Wernick and R. Pinner. *Metal Finishing,* v. 55, Mar. 1957, p. 58-61.

Typical flow sheet for plating by zinc-immersion. Discussion of platings which include copper, zinc, brass, cadmium, silver and chromium, applied directly on the zinc immersion deposit. (L17; Zn)

**294-L. Zinc Coatings. Complete Corrosion Protection at Lowest Over-All Cost.** F. P. Helms. *Oil and Gas Journal,* v. 55, Apr. 8, 1957, p. 106-109.

Some cost comparisons for different protective methods; galvanizing, zinc silicate formulations, high-temperature deposition of zinc dust. (L16, L general; *Zn*)

**295-L. Electroless Plating, Electro Forming, Mark Progress.** Fred W. Huntington. *Pacific Factory,* v. 87, Mar. 1957, p. 43.

Recent developments in plating and metal finishing. (L28, L18)

**296-L. Diffused Chrome Alloy Finishing Process.** John Starr. *Pacific Factory,* v. 87, Mar. 1957, p. 44-45.

Diffusion of chromium in ferrous parts so as to produce coatings which are alloys of the parent metals. (L15; *Cr*)

**297-L. AES Research Program.** Robert A. Ehrhardt. *Plating,* v. 44, May 1957, p. 489-509.

Brief account of American Electroplaters' Society research program. Summaries of progress for the following projects: Stripping copper from base metals, preparation for plating, adhesion, porosity, effect of impurities in plating solutions, mechanical finishing, testing thickness of deposits, and accelerated corrosion testing. (L17, A9)

**298-L. Fundamentals of Diffusional Bonding. Pt. I.** L. Castleman and L. Seigle. Sylvania Electric Products, Inc. *U.S. Atomic Energy Commission,* SEP-227, Aug. 13, 1956, 38 p.

Formation of intermediate layers in the diffusion zone of Al-Ni diffusion couples. This system was chosen because of its significance in fuel element technology. It has been confirmed that only two out of four possible layers form observably during diffusion—the $Ni_2Al_3$ and $NiAl_3$ phases. 16 ref. (L22, N1; Al, Ni)

**299-L. Study of the Feasibility of Coating Magnesium With High-Purity Aluminum.** C. F. Powell and I. E. Campbell. Battelle Memorial Institute (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121860, Nov. 1956, 28 p. $.75.

Feasibility of the vapor plating technique was investigated through a literature survey of aluminum compounds sufficiently unstable to be decomposed to yield aluminum metal at suitable plating temperatures. Most promising for further experimentation was pyrolysis of aluminum alkyls and of aluminum hydride and its derivatives at low pressures and at temperatures of 400 to 500° C. (L25; Mg, *Al*)

**300-L. (Czech.) Metallurgical Surface Treatment of Tin Plate.** J. Teindl and Antonin Hrbek. *Hutnické Listy,* v. 12, Apr. 1957, p. 329-332.

Studies on the oxidation of tin plate and the use of protective oxide coatings; recommendations for improving the resistance to corrosion. (L14a; *Sn,* 8-12)

**301-L. (French.) Kanigen Chemical Nickel Plating Process.** *Revue des Produits Chimiques,* v. 60, Feb. 28, 1957, p. 45-51.

History of process, theory, work done by General American Transportation Corp. to perfect process, properties of chemical nickel deposits, details on anticorrosion protection provided by such coating, applications. (L28; *Ni*)

**302-L. (German.) Ion Exchangers in Plating Technology.** Gunnar Gabrielson. *Metalloberfläche,* v. 11, Feb. 1957, p. 41-46.

Fundamental properties of ion exchange resins; technique of ion separation by means of ion exchangers; instruction for the selection of ion exchangers; application of ion exchangers in the analysis of plating solutions; characteristic data of some commercial ion exchange resins. 25 ref. (L17, A8b)

**303-L. (German.) Anodic Oxidation of Copper and Copper Alloys.** Hans Edner. *Metallwaren-Industrie und Galvanotechnik,* v. 48, Apr. 1957, p. 157-159.

Anodic dyeing of copper and its alloys is easier than blackening by other methods. Oxide layers are up to 3 microns thick, easily polished and heat resistant up to 200° C. (L19; Cu)

**304-L. (German.) Semi and Fully Automatic Grinding and Polishing.** O. Schleppi. *Metallwaren-Industrie und Galvanotechnik,* v. 48, Apr. 1957, p. 165-169, 188.

Choice of polishing emulsion or paste. Polishing wheel as applied to the use of European machinery (in contrast to equipment used in the United States). (L10b, 1-2)

**305-L. (German.) Theory and Engineering of Flame Cleaning.** Karl W. Sippell. *Werkstoffe und Korrosion,* v. 8, Apr. 1957, p. 185-216.

Influence of the flame temperature upon the properties of structural steels and the influence of several fuel gases upon the effectiveness of the method. 78 ref. (L10g; ST)

**306-L. (Book—Spanish.) Hard Chromium Plating; Practice and Applications.** Vincente Massuet Grau. 288 p. 1957. Editorial. J. Monteso, Barcelona, Spain.

Practical guide for metallurgist not familiar with electryoltic processes. In four parts: electrolytic chromium; plant and equipment; hard chromium plating practice; and industrial applications. (L17; *Cr*)

# M Metallography

## Constitution and Primary Structures

**185-M. Structures of ZrGe, HfSi₂ and HfGe₂.** J. F. Smith and D. M. Bailey. *Acta Crystallographica,* v. 10, Apr. 10, 1957, p. 341-342. (CMA)

X-ray diffraction of single crystals of $ZrGe_2$, $HfSi_2$ and $HfGe_2$ confirms earlier work on crystal structures. Layer-line symmetry and characteristic extinctions show that all belong in the space group $D^{17}_{2h}$-Cmcm. The compounds appear to be isostructural. (M26q, M22g; Zr)

**186-M. Titanium Metallurgy—Pt. II. Structure of Titanium Deposits Formed in Electrolytic Cells Using Fused Alkali Chloride Baths.** R. S. Dean, W. W. Gullett and F. X. McCawley. *Industrial Laboratories,* v. 9, May 1957, p. 10-12. (CMA)

Structure of titanium deposits produced by the electrolytic method of the Chicago Development Corp. The bundles of coarse filamentary particles originally have their interstices filled with salt, which is drained readily. The bundles are not dendritic, except when the cell geometry creates zones of very low cathode current density. Plate thickness and the extent of the fine crystal zone are directly related to the initial cathode current density. The initial cathode plate formed is ductile if formed on a titanium cathode. The formation of the large crystals in the outer zone is due to supersaturation of the zone with sodium. Sodium forms at the rate that titanium from titanium dichloride crystallizes out. The equilibrium is unusual. (M27d, C23p; Ti)

**187-M. Molybdenum-Rhenium System.** A. G. Knapton. *Institute of Metals, Bulletin,* v. 3, Mar. 1957, p. 161. (CMA)

Arc-melted molybdenum alloys with up to 100% Re studied from 900° C. to the liquidus. The solubility of rhenium in molybdenum falls from 42 at. % at 2400° C. to 27 at. % at 1000° C. One of the intermediate phases is of the alpha-manganese type and the other is of sigma structure; the previously reported face centered cubic lattice phase at 25 wt. % Re was not confirmed. The sigma-phase, which forms peritectically at 2500° C., is unstable below 1200° C. The other phase forms peritectoidally at 1850° C. from sigma and rhenium-rich solid solution. The maximum solubility of molybdenum in rhenium is 14 at. %. (M24b; Mo, Re)

**188-M. Titanium-Aluminum Alloys.** *Metal Industry,* v. 90, Apr. 26, 1957, p. 328, 331. (CMA)

It appears that the cost of ti-

tanium alloys may be justified in applications where the low density and good creep resistance in the range 300-500° C. are the desirable properties. Aluminum seems to be an essential addition for stress resistance at medium temperatures, due to the alpha-stabilizing nature of the addition. Further investigation of the titanium-aluminum system of alloys shows that increases of aluminum above 10% reduce the hot workability. Anomalous effects in elongation and ductility properties indicate phase changes, but altered microstructures were not detected. A study is cited which notes long-range ordering in alloys containing less than 20% Al. Many anomalies may be explained on the basis of $Ti_3Al$ superlattice formation. Other workers postulate the formation of an $alpha_2$ phase at 7.5% Al from a peritectoid reaction from the alpha-beta phase field. An (epsilon) field at high aluminum contents is also postulated. An inadequate understanding of the titanium-aluminum system is stressed.
(M24b, Q general; Ti, Al)

**189-M. Nature of Some Mechanically Polished Metal Surfaces as Evidenced by Epitaxial Phenomena.** L. E. Samuels. *Institute of Metals, Journal,* v. 85, Jan. 1957, p. 177-184.

Since the phenomenon of epitaxis might be expected to be sensitive to the presence of thin surface layers, experimental techniques based on it have been used in an endeavor to make a fresh approach to the problem of the existence of a Beilby layer on surfaces polished by mechanical metallographic methods. It is shown that electrodeposits formed on surfaces of copper, alpha-brass, tin, zinc, silver, and iron, and the overgrowths of alkali halides on surfaces of silver, are epitaxed after finish polishing by standard methods. (M26, M20p; 8-12)

**190-M. P-T-X Phase Diagrams of the Systems In-As, Ga-As and In-P.** J. van den Boomgaard and K. Schol. *Philips Research Reports,* v. 12, Apr. 1957, p. 127-140.

For the compounds indium arsenide, gallium arsenide and indium phosphide, the phase relations solid-liquid-vapor have been determined. Indium arsenide has a maximum melting point of 943 ± 3° C. at an arsenic pressure of 0.33 atm. Gallium arsenide has a maximum melting point of 1237 ± 3° C. at an arsenic pressure of 0.9 atm. For indium phosphide the maximum melting point is estimated to lie at 1062 ± 7° C. at a phosphorus pressure of approximately 60 atm. 8 ref. (M24d, N12; In, As, Ga)

**191-M.** (Italian.) **Metallography of Titanium.** D. Gualandi. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 149-158. (CMA)

Principal procedures for obtaining metallographic preparations of titanium and its alloys. These comprise methods of chemical etching and mechanical and electrolytic development of metallographic structures. Micrographs are presented illustrating the allotropic alpha-beta transformation as it is modified by the presence of carbon, hydrogen or oxygen or by the rate of cooling of the titanium samples. 21 ref. (M21, M27b; Ti)

**192-M.** (Russian.) **X-Ray Study of the Crystal Structure of the Compounds TiSi and TiGe.** N. Ageev and V. Samsonov. *Doklady, Akademiya Nauk S.S.S.R.,* v. 112, Feb. 11, 1957, p. 853-855. (CMA)

Measurements of the structure of TiSi and TiGe, synthesized from elements either by sintering or melting, were made using monocrystals extracted from shrinkage holes in melts. The lattice parameters of the orthorhombic crystals are, for TiSi: a = 3.61 Å, b = 4.96 Å, c = 6.47 Å; for TiGe: a = 3.80 Å, b = 5.22 Å, c = 6.82 Å. The distribution of atoms in the elementary cell, tentatively determined from the intensities of lines on the X-ray interference curve, was checked by comparison with lines on a calculated curve for a statistical distribution of atoms in the cell. 3 ref. (M26q, M22g; Ti, Si, Ge)

**193-M. Phase Diagram of the Binary System Titanium-Aluminum.** I. I. Kornilov, E. N. Pyleeva and M. A. Volkova. *Academy of Sciences of the U.S.S.R., Bulletin. Division of Chemical Science,* no. 7, July 1956, p. 787-795. (Translated by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N. Y.). (CMA)

Previously abstracted from original. See item 398-M, 1956.
(M24, Q29, Ti, Al)

**194-M. An Extraction Replica Method for Large Precipitates and Non-Metallic Inclusions in Steels.** G. R. Booker, J. Norbury and Richard Thomas. *British Journal of Applied Physics,* v. 8, Mar. 1957, p. 109-113.

A replica method which enables large (up to 10 microns or so) precipitates and inclusions to be extracted from steels. There is no etching through the replica, and consequently weakening and staining of the film are avoided. Examples of the extraction of iron nitride, iron carbide, and nonmetallic inclusions. 11 ref. (M20r; ST, 9-19)

**195-M. Constitution of Alloys of Iron and Manganese With Transition Elements of the First Long Period.** A. Hellawell and W. Hume-Rothery. *Royal Society of London, Philosophical Transactions,* v. 249, Ser. A, Mar. 14, 1957, p. 417-459.

Constitutions of iron-rich and manganese-rich binary alloys with the sequency of elements titanium-vanadium - chromium - (manganese, iron)-cobalt-nickel-copper were investigated by specially accurate thermal analyses, supplemented by microscopical and X-ray work. The liquidus and solidus curves were determined accurately. 27 ref.
(M24d; Fe, Mn)

**196-M.** (English.) **Crystal Habits of Silicon Crystallized in Al-Si Alloys.** Ichiji Obinata and Noboru Komatsu. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 107-117.

Aluminum alloys with 20% silicon containing none or only one of the following additional elements—sodium, magnesium, zinc, chromium, manganese, copper, cadmium, tin, lead, antimony, bismuth, iron, nickel and cobalt—were cooled very slowly or cast in sand molds. Then, the alloys were electrolyzed in hydrochloric acid solution by using a lead plate as the cathode. Silicon crystals thus obtained as the anode slime were collected and subjected to goniometry, X-ray and chemical analyses. From the above experiments, three types of crystal habits of silicon were detected.
(M26m, N12; Al, Si)

**197-M.** (German.) **Investigations of the Three-Component Systems Molybdenum-Silicon-Boron, Tungsten-Silicon-Boron and in the System $VSi_2$-$TaSi_2$.** H. Nowotny, E. Dimakopulou and H. Kudielka. *Monatsschrifte für Chemie,* v. 88, no. 2, 1957, p. 180-182. (CMA)

The phase diagram of the three-component system Mo-Si-B at 1600° C. shows mainly a ternary phase $Mo_5(Si,B)_3$ with T2 structure and in equilibrium with molybdenum; $Mo_3Si$, $Mo_5Si_3$ (type T1), $Mo_2B$ and MoB. The microhardness of the ternary phase is higher than that of the pure molybdenum silicides and seems even higher than that of the pure molybdenum borides. An isotype crystal structure exists also in the three-component system W-Si-B. Continuous solid solutions were found in the quasi-binary system $VSi_2$-$TaSi_2$. 17 ref.
(M24c; Mo, Si, B, W, V, Ta)

**198-M.** (Italian.) **On a New Etching Method for the Color Metallography of Copper-Bearing Light Alloys.** M. Leoni. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 170-172, 180.

The etch produces a thin epitaxial layer which gives rise to colorations in each crystal, which are related to the microstructure. It is possible to show the phases present in a given sample, as well as the degree of homogeneity of the solid solution. 11 ref. (M20q; Cu)

**199-M.** (Italian.) **Color Micrography as Applied to Common Brasses.** P. Lombardi. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 181-185.

Some color micrographical research related to common brasses and results obtained from examination of selected samples. Color micrography is carried out two different methods: (1) by formation of thin epitaxial films on the sample surface so that the crystal grains will be differently colored; and (2) by deep etching which shows the corrosion surfaces, different for each metal. Color micrography may be recommended only for particular analyses, the most important of which may be orientation of crystalline grains. 7 ref. (M20, M21; Cu-n)

**200-M.** (Italian.) **Structural Relation and Equilibria Between the Epsilon and Zeta Phases of the Fe-N System.** A. Burdese. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 195-199.

Equilibria between the epsilon and zeta phases of the Fe-N system and the structure of epsilon solids are discussed. 6 ref. (M24b; Fe, N)

**201-M.** (Italian.) **Single Etching Reagent for the Micrographical Examination of Ferritic, Martensitic and Austenitic (as Well of Sigma-Phase) Stainless Steels and High Speed Steels.** G. Catella and C. Giometto. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 200-205.

A reagent consisting of 1.2% solution of picric acid in ethylic acid, 100 cc.; hydrochloric acid, 10 cc.; and glacial acetic acid, 3 cc. was adopted.
(M20q; NM-a 31, SS, TS-m)

**202-M.** (Italian.) **Contribution to the Study of Nonmetallic Inclusions in Ferrochromium.** R. Zoja. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 206-211.

The morphology of inclusions in refined ferrochromium, and isothermal transformations of inclusions. 5 ref.
(M27; AD-n, Fe, Cr, 9-19)

# N Transformations and Resulting Structures

**181-N. Thermal Diffusion of Hydrogen in Zirconium. Preliminary Report.** J. M. Markowitz and J. Belle. *U.S. Atomic Energy Commission,* WAPD-TM-42. Feb. 1957, 19 p. (CMA)

The thermal diffusion of hydrogen into Zircaloy was studied in an effort to explain the corrosion failure under certain irradiation conditions. Two theoretical approaches to the problem are explored and experimental data are applied to both. The complicating precipitation of a hydride phase is noted. Thermal diffusion curves are shown and discussed for different phase regions of the zirconium-hydrogen system. In the two-phase region the concentration of the matrix is governed by the solubility curve. (N1; Zr, *H*)

**182-N.** (French.) **Elements of the Structural Metallurgy of Titanium and Its Alloys.** Adrien Saulnier. *Revue de l'Aluminium,* v. 34, Mar. 1957, p. 271-276. (CMA)

Below 885° C. pure titanium exists in the hexagonal alpha-phase, and at 885° C. it changes over by allotropic transformation into the cubic beta-phase. Most titanium alloys are formed by mixtures of these two phases. Characteristic alloy formations are the Ti-Al, the Ti-Fe and the Ti-V types. On further processing, depending on the degree of stabilization of the beta-phase, rapid cooling will bring about the martensitic alpha'-phase (from weakly stabilized beta-phase) or (from the highly stabilized beta-phase) the submicroscopic omega-phase and alpha-phase oriented in Widmänstatten figures. (N6p; Ti)

**183-N. Strain Figures Appearing on the Surface of Copper Electrodeposits Subjected to Fatigue.** M. Suzuki. *Institute of Metals, Journal,* v. 85, Jan. 1957, p. 206-208.

Effects of microstructure of the underlying metal upon the flecks and strain figures appearing on the surface of electroplated copper subjected to fatigue were investigated. Flecks appear in the region of the grain boundaries of the metal beneath. Grain boundaries run parallel to the direction of the planes of the maximum shear stress.
(N12d; Cu)

**184-N. Some Observations of the Effect of a Dispersed Oxide Phase on the Recrystallization of Copper.** J. W. Martin. *Metallurgia,* v. 55, Apr. 1957, p. 161-165.

Compares activation energy for recrystallization of specimens deformed and recrystallized under various conditions for pure copper, copper containing silicon in solid solution and copper containing dispersed silica particles; recrystallization followed microscopically and by hardness measurements. 28 ref. (N5f; Cu)

**185-N. Sigma Formation in Commercial Ni-Cr-Fe Alloys.** Francis B. Foley and Vsevelod N. Krivobok. *Metal Progress,* v. 71, May 1957, p. 81-86.

Formation of sigma phase in high chromium-nickel alloys of iron is usually blamed for embrittlement of the alloys after long heating, but there is reason to believe that some more subtle phenomenon is also a contributing factor.
(N8, Q6n, 3-18; SS)

**186-N. Existence of a Metastable Phase Isomorphous With the Stable Phase of a Pure Metal.** J. H. O. Varley. *Philosophical Magazine,* v. 2, 8th Ser., Mar. 1957, p. 384-388.

A study of the factors controlling the coefficient of volume expansion of a pure metal, in a previous paper, has led to the conclusion that there are two isomorphous states, differing only in volume, of any given crystal structure. The relative stabilities of these phases are discussed and the possibility of isomorphic transformations is examined. (N6)

**187-N.** (English.) **Diffusion of Hydrogen Through Iron and Binary Iron-Chromium and Iron-Nickel Alloys at High Pressures and Temperatures.** A. A. Shcherbakova. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 955-960. (Translated by Consultants Bureau Inc., 227 W. 17th St., New York 11, N.Y.)

Diffusion of hydrogen in chromium and nickel at temperatures from 200 to 600° C. and under a pressure of 100 atmospheres. Investigation of exponential relationship between the diffusion rate and the absolute temperature. 6 ref.
(N1, 1-13, 3-24; Fe, *Cr, Ni, H*)

**188-N.** (English.) **Pressure-Induced Diffusion and Deformation During Precipitation, Especially Graphitization.** Mats Hillert. *Jernkontorets Annaler,* v. 141, no. 2, 1957, p. 67-83.

How pressure differences in binary systems are originated during solid-state precipitation processes; effect of such differences on the course of the process.
(N7b, M24b, 3-24)

**189-N.** (French.) **Structural Influence of Common Cast Irons on Their Elastic Behavior.** Paul Le Rolland and Elisabeth Plenard. *Fonderie,* no. 134, Mar. 1957, p. 105-112.

Structure of the most common foundry irons, with consideration being limited to gray iron with laminated graphite and a ferritic-pearlitic matrix. Effect of cooling rate through the graphitization range; influence of the graphite structure; influence of the nature of the matrix on elastic properties.
(N8s, Q21; CI-n)

**190-N. Structure of Guinier-Preston Zones. Pt. II. Room-Temperature Aging of the Al-Cu Alloy.** Karel Toman. *Acta Crystallographica,* v. 10, Mar. 10, 1957, p. 187-190.

Determination of the coefficients dependent on the structure of the zone from the variation of the diffuse intensity by the method of least squares for the natural aged aluminum-copper alloy. From these the concentration of copper atoms in various atomic planes of the Guinier-Preston zone, as well as the displacements of these planes with respect to the matrix, were determined. 3 ref. (N7a; Al, Cu)

**191-N. Precipitation of Cu in Ge.** A. G. Tweet. *Physical Review,* v. 106, Apr. 15, 1957, p. 221-224.

Kinetics of precipitation of copper from supersaturated solid solution in germanium studied as a function of temperature and dislocation density in the samples. Results can be expressed as an exponential decay with time of the unprecipitated fraction of copper. (N7b; Cu, Ge)

**192-N. Isothermal Transformation in Relation to Heat Treatment of Steel.** C. E. Mavrocordatos. *South African Institute of Mining and Metallurgy, Journal,* v. 57, Dec. 1956, p. 305-323.

Review of the mechanisms of transformation; suggestions for further experimentation. 42 ref.
(N8g; ST)

**193-N.** (English.) **On the Effect of Alloying Elements on the Solubility of Carbon in Molten Iron.** Koji Sanbongi, Masayasu Ohtani and Koshi Toita. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 147-158.

The solubility of carbon in Fe-C-Si, Fe-C-Cr and Fe-C-Mn melts determined at 1540° C. Some considerations were made to generalize the effect of alloying elements on solubility, referring to the previous data on the solubility of carbon and nitrogen in iron melts. The factors which are responsible for these effects are discussed in relation to the periodic table.
(P12e, 1-10; Fe, *C*)

**194-N.** (Czech.) **Application of Micro-Analytical Methods in the Study of the Isothermal Decomposition of Austenite.** Josef Cadek and Karel Mazanec. *Hutnické Listy,* v. 12, Mar. 1957, p. 216-222.

Basic suppositions and conceptions of the modern theory of nucleus formation and growth of a new phase; special attention is given to the problem of the existence of fluctuations as a basic cause of forming nuclei of a new phase; growth of a new phase is considered to be a process of forming two-dimensional nuclei. 28 ref. (N8g, 1-4; ST)

**195-N.** (Czech.) **Study of the Transformation of Delta Ferrite in Stainless Steels 18-8-Ti With High Titanium Content.** V. Cihal and M. Prazak. *Hutnické Listy,* v. 12, Mar. 1957, p. 236-242. (CMA)

Using austenitic steel with 18% chromium and 9% nickel the authors investigated the behavior of delta ferrite, a phase that appeared in the steel when titanium (up to 0.8%) was added. The procedure followed was to obtain potentiometric curves of a corrosive etching and to compare the results with microscopic and electron microscopic metallograms. It was observed that the transformation of the ferrite was a function of the thermal treatment. At temperatures of 550-800° C. delta ferrite decomposes according to the reaction $\delta \rightarrow$ carbides $+ \gamma + \sigma$, while above 800° C. the phase reaction is $\delta \rightarrow$ carbides $+ \gamma$. The presence of $\sigma$-phase impairs the readiness of the steel to undergo the secondary passivation and changes the course of the polarization curve in the transpassive region. 26 ref.
(N8, 1-10; SS, *Ti*)

**196-N.** (Czech.) **Study of the Influence of Tungsten on the Magnitude of the Interlamellar Distance of Pearlite.** Karel Mazanec. *Hutnické Listy,* v. 12, Apr. 1956, p. 309-315.

On raising the content of tungsten from 0.42% to 1.50% the interlamellar distance increases about 42%. Tungsten probably raises the value of the coefficient of surface

tension on the cementite (carbide)—ferrite intermediate phase and that of the coefficient of surface tension on the cementite (carbide)—austenite intermediate phase. 13 ref. (N8h, 1-10; AY, *W*)

197-N. (German.) **Strain Relief and Recrystallization of Aluminum. Pt. 2.** D. Altenpohl. *Aluminium,* v. 33, May 1957, p. 306-317.

Strain relief and recrystallization in pure and superpure aluminum, the results of which are interpreted in the light of present-day knowledge. Effects of rate of heating, degree of reduction in cold rolling, purity, various additions, hardening and nature of grain boundaries in superpure aluminum. 37 ref. (N5; Al-a)

198-N. (Italian.) **On the Solubility and Reprecipitation Mechanism of Graphite in Cast Iron.** V. Gottardi. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 173-180.

Investigation of the solubility of graphite in the austenite of a ferritic spheroidal cast iron by microscopic observation and determination of microhardness. Study was made of the isothermal of graphitization occurring at 725° C. on lamellar and spheroidal pearlitic cast iron. 22 ref. (N8s; CI)

199-N. (Swedish.) **Decomposition of Delta Ferrite in High-Alloy Steels.** Kehsin Kuo. *Jernkontorets Annaler,* v. 141, no. 3, 1957, p. 146-174.

In Fe-M-C ternary systems, where M represents vanadium, chromium, molybdenum or tungsten, the delta-ferrite has an intermediate M content between those of the austenite and an alloy carbide; it is therefore possible for the former to decompose into an aggregate of the latter. This aggregate resembles pearlite in appearance when the transformation temperature is above 850° C., and the term delta eutectoid has been used to denote it. Below 850° C. the same aggregate very often displays an acicular appearance not unlike bainite. 32 ref. (N8; AY)

## Physical Properties

214-P. **Effects of Pressure on Binary Alloys. Pt. V and VI.** P. W. Bridgman. *American Academy of Arts and Sciences, Proceedings,* v. 84, no. 2, p. 131-177; 179-216.

Binary alloys of a number of metals with melting points not higher than a few hundred degrees were tested, and 14 metals with melting points ranging up to 1500° C. Temperature coefficient of resistance and the decrement of relative resistance are shown on following binary alloys: Cu-Si, Fe-Si, Ni-Si, Ag-Cu, Ag-Pd, Al-Cu, Al-Mg, Al-Zn, Au-Cu, Co-Fe, Cu-Gu, Cu-Ge, Cu-Ni, Cu-Zn and Mn-Ni. 13 ref. (P15g, M24b, 3-24)

215-P. **Resistance Minimum of Magnesium: Electrical and Thermal Resistivities.** D. A. Spohr and R. T. Webber. *Physical Review,* v. 105, Mar. 1, 1957, p. 1427-1433.

The electrical resistivity of the dilute manganese alloy specimen passed through a minimum at about 14° K. and increased by approximately 20% as the temperature was lowered to 1.5° K. An exactly analogous effect was found in the thermal resistivity as evidenced by (1) a constant Lorenz ratio at temperatures below 4° K., and (2) the equality of the percentage deviations of the respective resistivities from normal behavior over the entire range of measurements. 29 ref. (P15g, P11, 2-11; Mg)

216-P. **Experimental Study of the Optical Properties of Metals and the Relation of the Results to the Drude Free Electron Theory.** L. G. Schulz. *Advances in Physics,* v. 6, Jan. 1957, p. 102-144.

Experimental aspects of Drude free electron theory in connection with adsorptions of electromagnetic radiation and anomalous skin effect. 89 ref. (P17)

217-P. **Influence of Heat-Treatment on the Electrical Resistivity and the Thermal Conductivity of Electrodeposited Chromium.** R. W. Powell and R. P. Tye. *Institute of Metals, Journal,* v. 85, Jan. 1957, p. 185-192.

The thermal and electrical conductivities of electrodeposited chromium are shown to increase as a result of heat treatment. A detailed investigation of the properties has been made over a wide range of temperatures and for heat treatment temperatures extending to 1410 °C. (P11h, P15g, 2-14; *Cr*, 8-12)

218-P. **Melting Point of Niobium.** T. H. Schofield. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 372-374.

Experimental redetermination finds melting point of columbium samples containing 0.12% gaseous impurities and 1.9% tantalum is 2468 plus or minus 10° C. (P12n; Cb)

219-P. **Physical and Mechanical Properties of Niobium.** C. R. Tottle. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 375-378.

Experimentally determined data on thermal expansion at elevated temperatures, thermal conductivity, electrical resistivity and tensile properties of columbium at room and elevated temperatures. Results of creep tests on columbium and a columbium alloy with 6¼% molybdenum at 600° C.; effect of oxygen and alloying elements on mechanical properties and electrical resistivity at room temperature. (P11, P15g, Q27a, Q3m, 1-11; Cb)

220-P. **Magnetic Susceptibility of Alpha and Beta Brass.** B. G. Childs and J. Penfold. *Philosophical Magazine,* v. 2, 8th Ser., Mar. 1957, p. 389-403.

Magnetic susceptibility has been measured at 77 and 300° K. of a series of copper-zinc alloys, ranging in composition from 0-47.6 at. % zinc, and of one silver-cadmium alloy containing 30.5 at. % cadmium. 19 ref. (P16n; Cu-n)

221-P. **K Auger Yield for Tin.** J. A. V. Fairbrother, D. G. Parkyn and B. M. O'Connor. *Physical Society, Proceedings,* Section A, v. 70, Pt. 4, Apr. 1, 1957, p. 262-274.

The principle employed by Martin and Stockmeyer in their determination of the fluorescent yield for gases is extended in the present paper to a determination of the fluorescent yield for metals. 18 ref. (P17; Sn)

222-P. **Effect of Eddy Currents on Nuclear Magnetic Resonance in Metals.** A. C. Chapman, P. Rhodes and E. F. W. Seymour. *Physical Society, Proceedings,* Section B, v. 70, Apr. 1, 1957, p. 345-360.

A theoretical and experimental investigation of this effect is described. The theoretical treatment is developed for specimens in the form of (*a*) a flat plate, (*b*) a long cylinder and (*c*) a sphere; and is applicable to foils, wires and powders with spherical particles. 16 ref. (P18m; 4-6, 4-11, 6-18)

223-P. **Thermodynamic Properties of Titanium-Oxygen Solutions and Compounds.** A. D. Mah, et al. *U.S. Bureau of Mines, Report of Investigations* 5316, Mar. 1957, 33 p. (CMA)

Among the thermodynamic data presented are heats of formation for rutile and titanium-oxygen interstitial solutions, low-temperature heat capacities and entropies, free energies of formation and high-temperature heat contents. (P12; Ti, O)

224-P. **Effect of Radiation on the Thermal Conductivity of Uranium-1.6 w/o Zirconium.** H. W. Deem, et al. *U.S. Atomic Energy Commission,* BMI-986, Mar. 16, 1956, 19 p. (CMA)

Fuel rods of uranium with 1.6% Zr are being considered for the sodium-cooled, fast-neutron power reactor. The thermal conductivity is important and was tested for rods which had been irradiated in the MTR by Argonne. Measuring was accomplished by the heat wave method. The reduction in thermal conductivity for 0.21 and 0.75 at. % burnup was 8 and 9.5%, respectively. (P11h, T11g, 17-7, 2-17; U, *Zr*)

225-P. **Determination of Emissivity and Reflectivity Data on Aircraft Structural Materials. Pt. 1. Techniques for Measurement of Total Normal Emissivity and Reflectivity With Some Data on Copper and Nickel.** H. T. Betz. Armour Research Foundation. (Wright Air Development Center.) *U.S. Office of Technical Services,* PB 121817, Oct. 1956, 51 p. $1.50.

Equipment was designed, constructed and calibrated for measurement of total normal emissivity in the range minus 300-3000° F. For the measurement, the total normal radiance of a sample is compared to that of a comparison black body, and the ratio of the signals is taken as the emissivity. Measurements were made of the total normal emissivity for copper and nickel. (P17a, P17d, T24, 17-7; Cu, Ni)

226-P. **Electron Transport Properties of Dilute Binary Magnesium Alloys.** E. W. Kammer. Naval Research Laboratory. *U.S. Office of Technical Services,* PB 121851, Dec. 1956, 19 p. $.50.

Demonstrates that measurements of electron transport properties of dilute magnesium alloys are sensitive to the Brillouin zone overlap phenomena deduced earlier by X-ray techniques. Matthiessen's rule and Linde's rule were found invalid. (P15p; Mg)

227-P. **Semiconducting Intermetallic Compounds.** L. Pincherle and J. M. Radcliffe. *Advances in Physics,* v. 5, July 1956, p. 272-322.

Review of the preparation, properties, theory and applications of so-called semiconducting intermetallic compounds. 145 ref. (P15g, A general; SGA-r)

228-P. **Characteristics of Metal-Clad Laminates.** D. S. Hoynes. *Electrical*

*Manufacturing,* v. 59, Apr. 1957, p. 104-109, 352.

Tests were conducted on: (1) the current-carrying capacity of etched copper conductors; (2) resistance measurements on samples having a variety of protective coatings; and (3) dielectric properties of a number of metal-clad laminates at various temperatures. (P15; Cu, 8-16)

**229-P. Specific Heats of Some Metallic Elements. Pt. 1. Analysis of the Experimental Data.** C. V. Raman. *Indian Academy of Sciences, Section A, Proceedings,* v. 45, Jan. 1957, p. 1-6.

Specific heat data in the temperature range from 15 to 300° reported by Giaque and collaborators for the four metals aluminum, copper, silver and lead are analyzed and the effective average frequency of the atomic oscillators deduced therefrom is plotted as a function of the temperature. 7 ref.
(P12r, 2-11; Al, Cu, Ag, Pb)

**230-P. Specific Heats of Some Metallic Elements. Pt. 2. Approximate Theoretical Evaluation.** C. V. Raman. *Indian Academy of Sciences, Section A, Proceedings,* v. 45, Jan. 1957, p. 7-14.

Specific heats of the four metals aluminum, copper, silver and lead which crystallize as face-centered cubic lattices are evaluated in terms of the four characteristic frequencies of vibration of such a lattice, these latter being determined by an approximate method which relates them to the elastic constants of the crystal. Results discussed and compared with the experimentally determined specific heats. 8 ref.
(P12r, 1-4; Al, Cu, Ag, Pb)

**231-P. Quenching Vacancies in Gold.** F. J. Bradshaw and S. Pearson. *Philosophical Magazine,* v. 2, 8th ser., Mar. 1957, p. 379-383.

Increases in the electrical resistivity of gold wires due to quenching measured and interpreted in terms of vacancies. The energy for vacancy formation was deduced to be 0.95 electron volt and the concentration of vacancies at the melting point 6 x $10^{-4}$. Annealing measurements between 70 and 130° C. indicated that the movement energy of a vacancy was 0.68 electron volt and that it had on an average a life of $10^{8}$-$10^{9}$ jumps. 6 ref.
(P15g, M26s; Au)

**232-P. Atomic Heat of Cerium Between 1.5° and 20° K.** D. H. Parkinson and L. M. Roberts. *Physical Society Proceedings,* v. 70, May 1, 1957, p. 471-475. (CMA)

The specific heat of f.c.c. cerium between 1.5 and 20° K. shows a maximum at 12.5° K., the size of which increases with cooling time. The anomaly may be due to antiferromagnetism. 8 ref. (P12r; Ce)

**233-P. Magnetic Susceptibility of Ytterbium From 1.3° K. to 300° K.** J. M. Lock. *Physical Society Proceedings,* v. 70, May 1, 1957, p. 476-480. (CMA)

The magnetic susceptibility of ytterbium was measured at various temperatures. Only about 1/260th of the atoms are in the $^2F_{7/2}$ state (13 electrons in the 4f shell); the others are in the $^1S$ state. This is supported by the slight paramagnetic saturation effect at low temperatures.
(P16, 1-11; Yb)

**234-P. Surface Tension of Binary Liquid Mixtures: Lead-Tin and Lead-Indium Alloys.** T. P. Hoar and D. A. Melford. *Transactions of the Faraday Society,* v. 53, Pt. 3, Mar. 1957, p. 315-326.

Surface tensions of binary lead-tin and lead-indium alloys measured by an improved capillary method at temperatures ranging from the melting points to 550° C. Results compared with theoretical computations based on several previous equations, which are shown to be inadequate, and on a modified equation for a monolayer model of the surface of regular mixtures, which gives relatively good agreement with the experimental data. 22 ref. (P13h, 1-4; Pb, Sn, In)

**235-P. Heat Transfer to Lead Bismuth in Turbulent Flow in an Annulus.** R. A. Seban and D. F. Casey. University of Alabama. *U.S. Atomic Energy Commission,* AECU-3164, June 22, 1956, 16 p.

Heat transfer coefficients for molten lead-bismuth eutectic are presented for flow in annuli externally heated at a constant rate. Diameter ratios of 1.30 and 1.34 were investigated, and results were obtained for Peclet numbers from 400 to 1600. Results are shown to be related to analogy predictions for this system in the same manner as exist for pipe flow, and that the theories providing a rationalization of the results for pipe flow do so as well for the flow in an annulus. 8 ref. (P11k; Pb, Bi)

**236-P.** (French.) **Physical Adsorption on Raney Nickel.** Bernard Delmon and Jean-Claude Balaccaunu. *Comptes Rendus,* v. 244, Apr. 8, 1957, p. 2053-2056.

Raney nickel adsorbs physically in relatively large quantity the constituents of the liquid phase with which it is in contact. This selective adsorption follows Langmuir's formula and has no connection with chemical adsorption studied by kinetic methods. 4 ref. (P13d; Ni)

**237-P.** (Italian.) **Silicon, Germanium and Selenium, Semiconductor Elements.** Giovanni Porro. *Industria Mineraria,* v. 8, Feb. 1957, p. 69-76.

Concept of conductor metals, of semiconductor metals; theories on the conductivity of the latter; applications of semiconductors. 16 ref.
(P15g; Si, Ge, Se)

**238-P.** (Japanese.) **On the Change of Magnetic Properties Caused by Cold Drawing.** Shigeo Zaima and Zitsuya Shindo. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 250-253.

The change of magnetic properties of the mild steel caused by cold working as an aid for analyzing the mechanism of improvement of properties. (P16, 3-18; CN)

**239-P.** (Book.) **Solid State Physics.** A. J. Dekker. 540 p. Apr. 1957. Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N.Y. $9.

The book is presented in two parts, the first dealing essentially with topics which are discussed in terms of atoms with little or no reference to the electron theory of solids; the second dealing with the electronic properties of solids. It is intended as an introduction to the subject, and is directed to students of the senior undergraduate level.
(P general, M general, N general)

**240-P.** (Book.) **Introduction to Semiconductors.** W. Crawford Dunlap. 417 p. Apr. 25, 1957. John Wiley & Sons, Inc. 440 Fourth Ave., New York 16, N.Y. $11.75.

Unified elementary survey of the field, covering basic concepts, properties of materials, methods of measurement, applications. (P15)

## Q Mechanical Properties and Tests

**516-Q. Investigation of the Fracture of Light Rolled-Steel Sections.** K. J. Pascoe. *British Welding Journal,* v. 4, Mar. 1957, p. 133-146.

Lengths of light sections of mild steel and three structural alloy steels with discontinuities which included machined notches and welds were loaded in bending at 0 and minus 60° C. to investigate possibility of cleavage fracture.
(Q26n; CN, AY)

**517-Q. Temper Brittleness of Boron-Treated Steels.** S. J. Rosenberg. *National Bureau of Standards, Journal of Research,* v. 58, Apr. 1957, p. 175-187. (CMA)

Two series of boron-treated steels studied for the effect of titanium and zirconium on impact properties, particularly temper brittleness. Small amounts of titanium, such as introduced by boron addition agents, can increase the susceptibility to temper brittleness and impair the Charpy V-notch impact properties of steels tempered at 1200° F. No adverse effects were proved against zirconium.
(Q6n, Q26s, 2-10; ST, *B, Ti, Zr*)

**518-Q. Analysis of Zircaloy-2 Creep Data With Two Extrapolation Methods.** K. R. Merckx. *U.S. Atomic Energy Commission,* HW-42547, Apr. 17, 1956, 9 pp. (CMA)

Experimental creep data for Zircaloy-2 are extrapolated into the low creep rate range ($10^{-8}$ in. per in. per hr.). The temperature range for which experimental data are tabulated is 300-932° F. The low creep rates at 650 °F. are self-consistent, but are inconsistent with values obtained at other temperatures. This anomaly is considered in the light of strain aging and different creep laws. Equations used are shown. (Q3n; Zr)

**519-Q. Effect of Composition on the Stored Energy of Cold Work and the Deformation Behavior of Gold-Silver Alloys.** P. Greenfield and M. B. Bever. *Acta Metallurgica,* v. 5, Mar. 1957, p. 125-130.

Energy stored in chips formed by drilling at room temperature and at −195° C. was determined for five gold-silver alloys in composition range from 35 to 98 at. %. Energy varies with composition and temperature of deformation. Energy expended in deformation is larger at lower temperature and increases with increasing concentration of solute. 16 ref.
(Q24f, Q24g, 2-10; Au, *Ag*)

**520-Q. Effect of Graphitization of Steel on Stress-Rupture Properties.** Joseph G. Wilson. *American Petroleum Institute, Proceedings,* v. 36 (III), 1956, p. 78-86.

The most serious conditions encountered with regard to loss of rupture strength are the presence of defects in the welds and the presence of low-strength weld metal. Although concentrated forms of graphite at weld heat affected zones may adversely affect the rupture strength of steel within the concentrations encountered in this investi-

gation, other factors, such as weld quality, are of great importance. Random forms of graphite, even up to "moderate" degrees, in the unaffected parent metal do not appear to be detrimental to either rupture strength or rupture ductility.
(Q3m, N8s; ST)

**521-Q. Abrasion Resistance: Measurement of Coated Surfaces.** *Electroplating and Metal Finishing,* v. 10, Apr. 1957, p. 109-113.

Techniques and apparatus used in determining abrasion resistance of decorative or protective metal platings; several blasting and rubbing test methods. 12 ref.
(Q9n, 1-4; 8-12)

**522-Q. Fatigue Under Triaxial Stress: a Testing Machine and Preliminary Results.** J. L. Morrison and J. S. C. Parry. *Engineering,* v. 183, Apr. 5, 1957, p. 428-432.

An example of triaxial stress is provided by a thick cylinder subjected to repeated internal pressure.
(Q7f, 1-3)

**523-Q. Fatigue of Metals.** K. N. Leibovic. *Industrial Chemistry,* v. 33, Apr. 1957, p. 194-195.

Some aspects of metal fatigue of interest to chemical engineers, particularly on the design and use of structures and machines. (Q7, 17-1)

**524-Q. Testing Indentation and Abrasive Hardness of Hard Materials.** P. Grodzinski. *Industrial Diamond Review,* v. 17, Mar. 1957, p. 46-50.

Physical properties of diamonds; crystal structure, morphology and indentation hardness. Q29c; NM-k37)

**525-Q. Structural Damping of a Simple Built-Up Beam With Riveted Joints in Bending.** T. H. H. Pian. *Journal of Applied Mechanics,* v. 24, Mar. 1957, p. 35-38.

An analytical expression of the energy loss per cycle of static loading is derived in terms of amplitude of load, stiffness of rivets and tightness of joint. Experimental measurements on a test steel beam provide a qualitative verification of the theory. (Q8; ST)

**526-Q. Some New Data on High-Speed Impact Phenomena.** J. H. Huth, J. S. Thompson and M. E. van Valkenburg. *Journal of Applied Mechanics,* v. 24, Mar. 1957, p. 65-68.

Experimental results for steel, aluminum, brass, lead, magnesium and a magnesium-lithium alloy.
(Q6n; ST, Al, Cu, Pb, Mg)

**527-Q. A Theoretical Criterion for the Fracture of Metals Under Combined Alternating Stresses.** Takeo Yokobori. *Journal of Applied Mechanics,* v. 24, Mar. 1957, p. 77-80.

A criterion is developed on the basis of the present concepts of dislocations. (Q26r)

**528-Q. Creep Properties From Short Time Tests.** Ervin E. Underwood. *Materials and Methods,* v. 45, Apr. 1957, p. 127-129.

Curves illustrate straight-line relationship between ultimate tensile strength or creep-rupture stress and hot hardness; correlation of time and temperature parameters for high-alloy steel.
(Q3m, Q27a, Q29n; AY, SS)

**529-Q. Cold Work Improves Age Hardening Stainless.** John T. Richards and Ellsworth M. Smith. *Metal Progress,* v. 71, May 1957, p. 71-75.

Age hardenable stainless may require complex and precise heat treatments for optimum properties. When mill annealed strip is rolled to hard or half-hard temper it has fair formability and age hardens to higher strengths during a simple reheating. (Q23q, J27d, 3-18; SS)

**530-Q. Dynamics of Twinning and the Interrelation of Slip and Twinning in Zinc Crystals.** R. L. Bell and R. W. Cahn. *Royal Society Proceedings,* v. 239, Apr. 9, 1957, p. 494-521.

Zinc crystal wires in which the basal plane was nearly parallel to the wire axis were found to twin at abnormally high stresses. No single critical resolved shear stress exists; resolved shear stresses near 3.7 kg. per sq. mm. were common for short crystals, while longer crystals (which often fractured at the instant of twinning) had an average critical stress of 2.9 kg. per sq. mm.
(Q24a, Q24b; Zn)

**531-Q. Investigations of Deformation and Fracture of Metals.** R. P. Carreker, R. W. Guard and R. E. Lenhart. General Electric Research Laboratory. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 111838, May 1955, 25 p. $.75.

Plastic deformation behavior of pure metals as a function of temperature and grain size; correlations of the stress, strain and strain rate were made on a phenomenological basis for both tensile and creep tests and the resulting data applied to examination of current concepts of deformation. (Q24, Q26s)

**532-Q. Survey of Low-Alloy Aircraft Steels Heat Treated to High Strength Levels. Pt. 1. Hydrogen Embrittlement.** G. Sachs and W. Beck. Syracuse University. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121700, June 1956, 96 p. $2.50.

The magnitude of hydrogen embrittlement was found to depend greatly upon numerous mechanical, chemical and electrochemical factors encountered in the making, shaping, heat treating and finishing of aircraft parts.
(Q26s, T24, 17-7; AY, *H*)

**533-Q. Investigation of Forged Cobalt-Base Alloys for High-Temperature Applications.** R. R. MacFarlane, R. K. Pitler and E. E. Reynolds. Allegheny Ludlum Steel Corp. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121723, Oct. 1956, 36 p. $1.00.

Improvements in the high-temperature properties of a wrought cobalt-base alloy resulted from additions of aluminum, boron and titanium.
(Q general, 2-12, 2-10; Co, *Al, B, Ti*)

**534-Q. Effect of Changing Cyclic Modulus on Bending Fatigue Strength.** A. A. Blatherwick and B. J. Lazan. University of Minnesota. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121816, Oct. 1956, 129 p. $3.25.

A phenomenological study of the effect on fatigue strength of changes in the cyclic secant modulus, or the ratio of the maximum stress to the maximum strain of the cyclic stress-strain hysteresis loop. (Q7g)

**535-Q. Materials - Property - Design Criteria for Metals. Pt. 4. Elastic Moduli, Their Determination and Limits of Application.** S. A. Gordon, R. Simon and W. P. Achbach. Battelle Memorial Institute. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121857, Oct. 1956, 23 p. $.75.

The modulus of elasticity at elevated temperatures for several materials as it is derived from the conventional stress-strain curve and from the determination of the velocity of propagation of elastic waves. (Q21a, 1-4, 2-12)

**536-Q.** (Czech.) **Internal Damping of Chromium Steels.** Joseph Vodsedalek. *Materialovy Sbornik,* 1956, p. 5-25.

Definitions of the internal damping of materials; causes discussed; factors which influence damping determined. The magneto-mechanical component of damping is treated with great care since it plays a principal part with chromium steels at the usual cyclic tensions. 12 ref.
(Q8; AY, *Cr*)

**537-Q.** (French.) **Influence of Graphite on the Mechanical Characteristics of Unalloyed Gray Iron With Laminated Graphite.** Michel Ferry. *Fonderie,* no. 134, Mar. 1957, p. 113-131.

Discusses changes in strength and structure as determined by graphite content with special reference to density, modulus of elasticity, hardness and tensile strength. Experimental conditions are outlined together with resultant conclusions. 18 ref. (Q general, 3-21, CI-n)

**538-Q.** (French.) **Alloyed Cast Irons With Spheroidal Graphite. Some Recent French Applications.** R. A. Chavy. *Revue de Nickel,* v. 23, Jan-Feb-Mar. 1957, p. 13-17.

Improved mechanical and physical properties of gray iron resulting from the substitution of spheroidal graphite for laminated graphite. Discusses nickel-manganese and nickel - molybdenum - manganese alloys. (Q general, M27, 3-21; CI-r)

**539-Q.** (French.) **Hydraulic Recoil in Iron Wire.** A. De Saedeleer. *Revue Universelle des Mines,* v. 13, Apr. 1957, p. 142-153.

Consideration of plastic deformation resulting from the breaking of metallic wire by traction. The sudden removal of the original state of stress produces in the sections a longitudinal vibratory movement. Analysis of vibratory phenomena.
(Q10, Q8; Fe, 4-11)

**540-Q.** (German.) **On the Characteristics of Impact-Stressed Nitrided Steels.** H. Wiegand and M. Koch. *Werkstatt und Betrieb,* v. 90, May 1957, p. 269-273.

Characteristics of nitrided parts in the case of stressing due to tension, variation and impact.
(Q6n, Q27a; ST, 14-19)

**541-Q.** (German.) **Admissible Stresses of Shafts in Machine Building.** Richard Hänchen. *Werkstatt und Betrieb,* v. 90, May 1957, p. 317-321.

Fatigue resistance for smooth shafts, admissible stresses for deflection and torsion, and admissible bending and torsion stresses for shafts with shoulders, cross drillings and hub seats. (Q7a, Q1a, Q5g, 17-1)

**542-Q.** (Italian.) **Anisotropy and Nonhomogeneity of Fatigue Resistance in High-Strength Light Alloys.** C. Panseri and F. Gatto. *Alluminio,* v. 26, Mar. 1957, p. 101-106.

Experiments showed fatigue resistance of extruded bars of Avional (Al-Cu-Mg) to be greater longitudi-

nally (in direction of extrusion) than in transverse directions and at 45°; moreover, samples taken from sides of extruded material showed a greater resistance than those taken from center. Anisotropy and nonhomogeneity not found in Ergal (Al-Zn-Mg-Cu). 7 ref. (Q7a, 1-10; Al, 4-8)

**543-Q.** (Italian.) **Influence of Specimen Shape on the Fatigue Resistance of Al-Zn-Mg-Cu Alloy (Ergal 65TA). New Studies.** F. Gatto. *Alluminio,* v. 26, Mar. 1957, p. 107-110.

Toroidal and cylindrical specimens tested; rotary bending strength was not appreciably influenced by shape of specimens. 6 ref. (Q7g, 1-10; Al)

**544-Q.** (Polish.) **Use of Other Elements in Place of Molybdenum in Steels for Steam Superheater Tubes.** W. Tomaszczyk. *Prace Instytutow Ministerstwa Hutninctwa,* v. 9, 1957, p. 13-40.

A group of steels with a lower content of molybdenum was investigated: chromium-molybdenum type, chromium - molybdenum - vanadium type, manganese-silicon type, chromium-vanadium type, chromium-tungsten type and chromium-tungsten-vanadium type. The behavior of these steels was investigated in tension tests and impact tests at room and at elevated temperatures. 37 ref. (Q27a, Q6n, 1-12; AY, 4-10)

**545-Q.** (Polish.) **Coarse Crystalline Fracture of 18 HNWA Steel.** J. Ogerman. *Prace Instytutow Ministerstwa Hutnictwa,* v. 9, 1957, p. 41-55.

Trials were made to determine the effects on 18 HNWA steel fracture caused by annealing at high temperature (in the range between 1200 and 1350° C.), the rate of cooling from the above temperatures, the applied final heat treatment and the extent of forging. 29 ref. (Q26, M27d, 2-14; AY)

**546-Q.** (Portuguese.) **Dynamic Traction Tests on Steel.** R. M. Otto Weinbaum. *ABM, Boletim da Associacao Brasileira de Metais,* v. 13, Jan. 1957, p. 41-49.

Tests performed on notched specimens of mild steel; volume of notched section was varied in five different sets of test pieces. Tests confirm that the greater the volume of the material subjected to stress, the larger the amount of energy consumed in fracture of test piece. (Q27, 1-10; CN)

**547-Q. Brittle Fracture: a Hazard in Chemical Plant.** A. A. Wells. *British Chemical Engineering,* v. 2, Apr. 1957, p. 186-191.

Conditions which give rise to brittle fractures and discusses practical precautionary measures; transition temperature, residual stress and plastic strain distribution in welded parts are illustrated. 7 ref. (Q26s, Q23r, T 29, 17-7; 7-1)

**548-Q. Suitability of Quenched and Tempered Steels for Pressure Vessel Construction.** Leon C. Bibber. *Compressed Gas Assocication,* 43rd Annual Report, Supplement, 1955, p. 17-32.

Amount of ductility needed for fabrication and operation, elastic ratios, relationship between ductility and toughness, the necessity for stress-relieving; destructive tests of eight full-scale pressure vessels. 8 ref. (Q23p, Q21, T26q, 17-7; ST)

**549-Q. Influence of Surface Roughness on the Fatigue Strength of Steels and Nonferrous Alloys.** E. Siebel and M. Gaier. *Engineers Digest,* v. 18, Mar. 1957, p. 109-112. (Translation from *VDI Zeitschrift,* v. 98, Oct. 31, 1956, p. 1715-1723).

From a series of steels and nonferrous alloys in a specified heat treated condition, fatigue test specimens were machined to a specified degree of surface roughness and were tested in push-pull, bending, tension, and torsion. An attempt is made to establish design formulas for various machining processes from the results of these tests. 7 ref. (Q 7a, G17, 17-1)

**550-Q. Fatigue of Aircraft.** P. L. Teed. *Institution of Production Engineers, Journal,* v. 36, Mar. 1957, p. 154-164.

History of fatigue theory; causes of fatigue; discussion of stress concentrations, scatter in fatigue test results and influence of built-in stresses. (Q7, T24, 17-7)

**551-Q. On the Stress Distribution at the Base of a Stationary Crack.** M. L. Williams. *Journal of Applied Mechanics,* v. 24,, Mar. 1957, p. 109-114.

Remarks upon antisymmetric, as well as symmetric, stress distribution, and the circumferential distribution of distortion strain-energy density. (Q25k, 9-22)

**552-Q. Neutron Radiation Effects on Tensile and Impact Properties of ASTM-A302 B Steel.** E. E. Baldwin. *Mechanical Engineering,* v. 79, Mar. 1957, p. 261-265.

Comparison of tensile and impact data on irradiated and unirradiated specimens showed that the separate and combined effects of temperature and radiation had only minor effects (less than 10%) upon tensile and impact properties. (Q27a, Q6n, 2-17; AY)

**553-Q. Rupture Strength of Several Nickel-Base Alloys in Sheet Form.** James H. Dance and Francis J. Clauss. *National Advisory Committee for Aeronautics,* Technical Note 3976, Apr. 1957, 24 p.

An investigation was conducted to determine the 100-hr. rupture strengths at 1200 and 1350° F. of Inconel "X", Inconel 700, Incoloy 901, Refractaloy 26, and R-235 sheet alloys in both the annealed and heat treated conditions. Strengths of these alloys were compared with published data for other sheet alloys and bar stock. 15 ref. (Q3m; Ni, 4-3)

**554-Q. Work-Hardening and Work-Softening of Face-Centered Cubic Metal Crystals.** A. Seeger, J. Diehl, S. Mader and H. Rebstock. *Philosophical Magazine,* v. 2, 8th ser., Mar. 1957, p. 323-350.

Investigates by experiment and theory the mechanisms governing work-hardening, work-softening and slip band formation in face-centered cubic metals. 45 ref. (Q24, M26)

**555-Q. Metal Fatigue at High Frequency.** E. A. Neppiras. *Physical Society Proceedings, Section B,* v. 70, Apr. 1, 1957, p. 393-401.

Metal samples were subjected to tension-compression stresses above the fatigue limit at frequencies around 18 kc. produced by a resonant magnetostriction transducer. The work has shown that the high-frequency technique possesses a number of advantages over conventional methods of fatigue analysis. But the measurements confirm that at this frequency the fatigue limit is appreciably higher than that obtained from low-frequency measurements. (Q7, 1-4)

**556-Q. Hardness of Printing Metals.** F. G. Wallis. *Process,* v. 64, Mar. 1957, p. 106-107.

Determination of the effects of heating upon the hardness of metals and the effects of processing and printing upon hardness. (Q29n, T9n, 17-7)

**557-Q. True Stress-Strain Properties of Natural Uranium.** M. T. McGowan and R. M. Treco. Bridgeport Brass Co. *U.S. Atomic Energy Commission,* BRB-34, Nov. 30, 1956, 25 p.

It is shown that a composite true stress-strain curve for uranium may be derived from a combination of swaging prestrains and conventional tensile testing. (Q25n; U)

**558-Q. Relationship of Hardness Measurements to the Tensile and Compression Flow Curves.** R. E. Lenhart. General Electric Research Laboratory. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121144, June 1955, 14 p. $1.50.

Correlation of hardness and tensile tests and conversion of one measurement to the other was found workable. Results of experimentation with magnesium-aluminum alloys showed that the approximation of a uniaxial tensile stress flow curve from hardness measurements is possible by utilizing empirical conversion constants. (Q29n, Q27a)

**559-Q. Creep, Fracture, and Bending of Lead and Lead Alloy Cable Sheathing.** Curtis W. Dollins and Cecil E. Betzer. *University of Illinois Engineering Experiment Station,* Bulletin 440, Nov. 1950. $.65.

Tests have covered principally long-time creep under steady tensile stresses up to 300 psi. at 110 and 150° F., time to fracture and ductility under steady stresses of 400 to 1800 psi. at room temperature and 110° F., and life to fracture in slow bending to strains of 0.3 to 0.5%. The arsenical lead alloys have outstanding ability to withstand slow bending of the type that occurs in service because of the daily expansion and contraction of the cable in the duct between manholes. (Q3m, Q5g, T1b, 17-7; Pb)

**560-Q. Static Strength of Rivets Subjected to Combined Tension and Shear.** William H. Munse and Hugh L. Cox. *University of Illinois Engineering Experiment Station,* Bulletin 437, Dec. 1956, $.45.

A large number of rivets have been tested to determine the behavior of rivets under combined stresses and to evaluate the effect on this behavior of such variables as type of rivet, grip, diameter and method of driving. It has been found that a relatively simple relationship can be derived which expresses the strength of a rivet in terms of the shear and tension to which it is subjected. (Q27a, Q2g, K13n, T7d, 17-7)

**561-Q. Torsional Properties of Steels at High Rates of Strain.** Paul G. Jones and Thomas J. Dolan. *University of Illinois Engineering Experiment Station,* Bulletin No. 438, Feb. 1957, $.35.

Effects of strain rate, temperature, type of notch and size of specimen on four steels tested in torsion. Torque, angle of twist and time were continuously recorded and properties were determined. (Q1a, 1-4)

**562-Q. Influence of Weld Faults on Fatigue Strength With Reference to Butt Joints in Pipe Lines.** R. P. Newman. *Welding Research Abroad,* v. 3, Mar. 1957, p. 9-28.

Testing was by alternating plane bending to develop stresses transverse to the joint. It was found that the root zone of welds, with and without backing rings, exercised a predominant influence on fatigue behavior. Except in the case of lack of pentration, defects had no significant effect on fatigue strength because of the over-riding influence of root zone. (Q7a, K9)

**563-Q.** (English.) **Shear Strength at Elevated Temperatures of an Aluminium Alloy Honeycomb Core Bonded to Loading Plates With Two Types of Adhesive Films.** Bryan R. Noton. *Flygtekniska Försöksanstallen, Aeronautical Research Institute of Sweden Report 72,* Jan. 1957, 35 p.

Shear tests have been carried out at temperatures up to 100° C. on a honeycomb core from the U.S.A. in 3S-H19 aluminum alloy. The density of the core was 87 kg. per cu. m. (5.4 lb. per cu. ft.). The cell size was 9.5 mm. (0.375 in.) and the foil thickness, 0.1 mm. (0.004 in.) The Redux 775 and the Bloomingdale FM-47 adhesive films were investigated for bonding the core to the shear-transmitting plates. 15 ref. (Q2g, 1-1222; Al, 7-9)

**564-Q.** (Czech.) **Plastic Deformation of Steel.** Jaroslav Nemec. *Hutnické Listy,* v. 12, Apr. 1957, p. 315-324.

Fundamental questions concerning the possibility of calculating plastic deformation in inhomogenous material; examines static strength of ductile steels from fundamental physical deformation values of ferrite; discusses the mathematical bases as well as conclusions of the theory of instantaneous states in plastic deformation, and the theory of plastic deformation velocity; the results indicate the range of validity and applicability of the theory of instantaneous deformation states in plastic steels. (Q24; ST)

**565-Q.** (Czech.) **Contribution to the Investigation of the Qualities of Heat Resisting Iron-Aluminum Alloys.** Jaroslaw Pluhar. *Materialovy Sbornik,* 1956, p. 97-115.

Strength at high temperatures, weldability and heat resistance of welds are treated in detail. Tendency of decomposition of some of these alloys, and conditions to prevent this phenomenon. The properties of Pyroferal are compared with those of the usual heat resistant alloys of the chromium and chromium-nickel type. 24 ref.
(Q general, 2-12; SGA-h, Fe, Al)

**566-Q.** (French.) **On the Resistance of Metals to Repeated Shock.** Jean Fossiez, Raymond Sitte and Stanislas Ziembinski. *Comptes Rendus,* v. 244, Feb. 18, 1957, p. 1008-1011.

Experiments on steel: successive sharp tensile stresses produced by a periodically excited electromagnet, intensity measured by a piezoelectric quartz dynamometer. Influence of frequency of shock; pseudo-aging of the metals; influence of elastic shocks. (Q6p)

**567-Q.** (French.) **Conditions Governing the Appearance of the Yield Point at the Elastic Limit as Observed on the Stress-Strain Curves of Pure Iron.** Bernard Migaud and Jean Talbot. *Comptes Rendus,* v. 244, Mar. 25, 1957, p. 1771-1774.

Reference is to Cottrell's interpretation of yield point of stress-strain curves of iron when passing from elastic to plastic state. This yield point no longer exists after a cold reduction operation but reappears in the case of pure electrolytic iron containing a trace of carbon and only when it precipitates from the solid solution. 5 ref. (Q21; Fe-a)

**568-Q.** (French.) **Water Hammer Effect in an Iron Wire.** A. de Saedeleer. *Revue Universelle des Mines,* v. 13, April, 1957, p. 142-153.

Analysis of vibratory phenomenon occurring at imbedded ends of wire broken on tensile test machine. (Q27f; Fe, 4-11)

**569-Q.** (German.) **On the Attainable Accuracy of Ball Thrust Hardness Tests and Gaging the Indentation Depth.** Kurt Potyka. *Werkstatt und Betrieb,* v. 90, May 1957, p. 274-276.

Brinell and Vickers hardness tests, when done without first grinding the test area, showed no satisfactory results with regard to the accuracy of the hardness values to be determined. (Q29b)

**570-Q.** (Italian.) **Sulphur Surface Hardening of Steel: Morphology and Characteristics of Layers.** N. Collari and P. Virdis. *Metallurgia Italiana,* v. 49, Mar. 1957, p. 159-169, 211.

The layers obtained on steel through a sulphur hardening treatment, and anti-friction properties in friction couplings have been chemically and metallographically tested to ascertain wear resistance. The possible causes, both chemical and physical, which may determine the favorable anti-wear and anti-friction behavior are briefly reviewed. 28 ref. (Q9n, J28; ST)

**571-Q.** (Italian.) **Influence of Work Hardening and Annealing on Mechanical Properties of Al-Mg Alloys.** F. Gatto and L. Mori. *Metallurgia Italiana,* v. 49, Apr. 1957, p. 253-264.

Experimental investigation on work hardening and annealing of aluminum-magnesium alloys with different magnesium contents, carried out mainly through tensile tests. The results were analyzed by showing the influence of work-hardening degree, annealing temperature, treating time, and magnesium content. (Q23a, J23; Al, Mg)

**572-Q.** (Italian.) **Zama Alloys for Die Castings.** Ludovica Alladio. *Rivista di Meccanica,* no. 156, Mar. 2, 1957, p. 31-33.

Effects of aluminum, copper, magnesium, lead, cadmium, tin and iron content on mechanical properties of die castings made of Zama alloys. (Q general, 1-10; Zn, 5-11)

**573-Q.** (Japanese.) **Fatigue Life of Metallic Materials Under Varying Repeated Stresses of Two Different Stress Waves.** Toshio Nishihara and Toshiro Yamada. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 136-141.

Notched specimens of carbon steel and duralumin tested and results were used to calculate fatigue life. (Q7b; CN, Al)

**574-Q.** (Japanese.) **On the Fracture of Metals (2nd Report). Tensile Fracture Test of Mild Steel Round Bars Having Hyperbolic Notch and Notch Brittleness.** Masuji Uemura. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 148-154.

Based on the premise that there exist shear and tensile fracture modes, various fracture behaviors are explained together with some observations on notch brittleness. 11 ref. (Q26; CN)

**575-Q.** (Japanese.) **Primary Creep of Mild Steel.** Toshio Nishihara, Shuji Taira, Kichinosuke Tanaka and Masateru Onami. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 154-159.

An empirical formula is introduced concerning the relation between transient creep rate, stress and temperature. (Q3m, Q3n; CN)

**576-Q.** (Japanese.) **On the Fatigue Limit of Steel Specimens With Cold-Rolled V-Notch. (Increase of Fatigue Strength Due to Artificial Aging.)** Yuich Kawada and Hajime Nakazawa. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 190-193.

Extent of the effect of low-temperature annealing; variation in hardness due to aging. 8 ref.
(Q7a, 2-15; ST)

**577-Q.** (Japanese.) **Study on Some Effects on Shore Hardness Number (5th Report) on the End Effect.** Shuro Machida. *Japan Society of Mechanical Engineers, Transactions,* v. 23, Mar. 1957, p. 230-237.

Tests made with Shore scleroscope of D-type on many specimens of different hardness. The end effect on the Shore hardness number is explained. (Q29)

**578-Q.** (Japanese.) **On the Changes of Mechanical Properties and Microstructures of Commercially Pure Titanium Sheets by Cold Rolling and Annealing. I.** Y. Kondo and S. Suzuki. *Sumitomo Metals,* v. 8, July 1956, p. 26-47. (CMA)

Microstructural and mechanical property changes in commercial titanium sheet from cold rolling and annealing included a loss of ductility at about 500° C. and a higher hardness at the surface than below it for cold rolled specimens. Heating and cooling speeds showed no effect on the hardness and tensile properties. Tensile properties vs. tensile speed, specimen shape and annealing time and temperature were among the relationships studied. Work hardening and annealing characteristics are discussed. (Q27a, Q29n, M27a, 2-14, 318; Ti-a, 4-3)

**579-Q.** (Pamphlet.) **Engineering Properties of Nickel. Technical Bulletin T-15, 7th Ed. 23 p. 1956.** International Nickel Co., Inc., 67 Wall Street, New York 5, N. Y.

Tables and graphs of mechanical property ranges of nickel alloys.
(Q general; Ni)

**580-Q.** (Pamphlet.) **Engineering Properties of "K" Monel and "KR" Monel. Technical Bulletin T-9, 12th Ed. 27 p. 1956.** International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Graphs, tables and notes.
(Q general; Ni)

## Corrosion

**221-R. Protective Sodium Benzoate Impregnated Jute Wrappings for Steel Parts.** T. H. Soutar. *Corro-*

*tries,* v. 116, May 1, 1957, p. 106. (CMA)

In testing a welded tank of A-110AT, numerous weld cracks developed from internal pressure at 700° F. The tank was filled with a chlorinated hydrocarbon. Further study showed that the hydrocarbon caused stress-corrosion cracks at 700° F. which tend to follow the direction of rolling.
(R1d; Ti, 7-1)

**203-R. Titanium Corrosion and Inhibition in Fuming Nitric Acid.** H. B. Bomberger. *Corrosion,* v. 13, May 1957, p. 17-21. (CMA)

Titanium corrodes rapidly and a pyrophoric deposit forms in red fuming nitric acid when there is no access to air. Adding air or anhydrous copper sulphate reduces corrosion markedly. Such attack is intergranular and beta-phase is removed preferentially in a two-phase alloy, leaving pyrophoric alpha. Adding 1.5% $H_2O$ increased the corrosion rate but staining, cracking or pyrophoricity was not evident. Inhibition of corrosion is believed to be due to an adsorbed layer of ions on the titanium. (R6g, R10b; Ti)

**204-R. Effect of Pre-Oxidation in Oxygen on the Steam Corrosion Behavior of Zircaloy-2.** D. E. Thomas and S. Kass. *Electrochemical Society, Journal,* v. 104, May 1957, p. 261-263. (CMA)

Exposing Zircaloy-2 to dry oxygen had no effect on corrosion behavior, as the kinetics remained the same. Corrosion product hydrogen from steam is therefore not implicated. Zirconium exposed to dry oxygen shows neither spalling nor the rate transition from quasi-cubic to linear as is normal. Breakaway occurs with zirconium regardless of pre-oxidation, and thus hydrogen pickup is implicated. Alloying additions prevent breakaway but promote the rate transition. (R4d; Zr)

**205-R. Aqueous Corrosion of Uranium Fuel-Element Cores Containing 0 to 20 w/o Zirconium.** D. R. Greiser and E. M. Simons. *U.S. Atomic Energy Commission,* BMI-1156, Jan. 7, 1957, 29 p. (CMA)

A device used to test the aqueous corrosion of uranium fuel cores with up to 20 % Zr is described. Time-lapse movies of the swelling and rupture were taken of deliberately defected zirconium-clad samples. Corrosion rates were calculated from temperature and pressure measurements. (R4, 1-3, T11g, 17-7; U, *Mo*)

**206-R. Corrosion Properties of Zirconium-Base Fuel Alloys.** S. Kass. *U.S. Atomic Energy Commission,* WAPD-136, Nov. 2, 1957, 41 p. (CMA)

Zirconium-base alloys were studied in 680° F. water and in steam at 750° F. and 1500 psi. The corrosion of Zr alloys with 4 to 15% U follows a course of initial formation of an oxide film, film breakdown and general spalling. The corrosion resistance decreases with higher contents of uranium, but tin improves the corrosion resistance of the alloys. Using Zircaloy-2 instead of zirconium gave no improvement. Adding up to 1% Fe had bad effects on the corrosion properties of Zr-U-Sn alloys. The 4% U, 8% Cb alloy shows promise as a corrosion resistant fuel alloy. (R4, 1-10, T11g, 17-7; Zr)

**207-R. Corrosion in Distilling and Vacuum-Distilling Plants for the Processing of Middle East Crude Oils.** W. A. Derungs. *American Petroleum Institute, Proceedings,* v. 36 (III), 1956, p. 49-54.

Mild steel can be used extensively in atmospheric and vacuum-distillation units, provided that the maximum operating temperature is restricted to 300 to 330° C.; that 3% by weight of aqueous caustic soda mixed with cold crude oil is injected into the feed line between heat exchangers and furnace; and that 3% by weight of aqueous ammonia is injected into the overhead line.
(R7a; CN)

**208-R. High-Temperature Hydrogen-Sulfide Corrosion in Commercial Sovaformer Units.** E. B. Backensto, R. D. Drew and J. N. Vlachos. *American Petroleum Institute, Proceedings,* v. 36 (III), 1956, p. 55-67.

Corrosion test results obtained in two commercial Sovaformers (static-bed reformers utilizing a platinum-type catalyst) are presented for a wide variety of commonly used steels. Summary curves are presented which relate temperature and concentration of hydrogen sulphide to corrosion rates for 0 to 5% chromium steels and for chromium-nickel austenitic steels.
(R7k, R11; SS)

**209-R. How Richfield Plans to Combat High-Temperature Sulfide Corrosion in Its New Catalytic Reformer.** R. W. Neumaier and C. M. Schillmoller. *American Petroleum Institute, Proceedings,* v. 36 (III), 1956, p. 68-77.

Anticipated maximum corrosion rates have been plotted for different hydrogen sulphide concentrations. The importance of applying corrosion control in the design stage of the unit is stressed.
(R7k, T29n, 17-7)

**210-R. Stress-Corrosion of Wrought Ternary and Complex Alloys of the Aluminum-Zinc-Magnesium System.** R. Chadwick, N. B. Muir and H. B. Grainger. *Institute of Metals, Journal,* v. 85, Jan. 1957, p. 161-170.

Equipment employing spring loading combined with a dash-pot device to absorb energy released by the breaking of a stressed specimen was used to establish stress vs. time-to-failure relationships. Wrought ternary alloys with 5-9% zinc and 0.4-2.8% magnesium, and complex alloys with 7% zinc and 2¼% magnesium with smaller amounts of copper, manganese and chromium were studied.
(R1d, 1-3; Al, *Zn, Mg*)

**211-R. How-To's on Reducing Corrosion.** Larry Resen. *Oil and Gas Journal,* v. 55, Apr. 2, 1957, p. 116-117.

Suggestions for control of corrosion in an alkylation unit include: use of plastic linings and inhibitors, and positive control of caustic strength and circulation.
(R6j, R10)

**212-R. How to Stop Corrosion Under Insulation.** H. M. Wilten. *Petroleum Refiner,* v. 36, Apr. 1957, p. 192-193.

Brief discussion on specification or insulating piping and equipment; preparation of surfaces, material and application. (R10; 4-10)

**213-R. Approaching Problems of Cooling Water Corrosion.** M. C. Forbes. *Petroleum Refiner,* v. 36, Apr. 1957, p. 164-165, 216.

Only two variables are really important; effect of conductivity and effect of inhibitor on anodic and cathodic areas. (R4a, R10b)

**214-R. Investigation of Scaling of Zirconium at Elevated Temperatures. Quarterly Status Report No. 15 for Dec. 2, 1956 to Mar. 2, 1957.** H. B. Probst, E. B. Evans and W. M. Baldwin, Jr. *U.S. Atomic Energy Commission,* AECU-3424, Mar. 6, 1957, 7 p. (CMA)

Instantaneous scaling rates were determined to show the effects of oxygen and nitrogen on the scaling behavior of zirconium at 800° C. Scaling runs in air after prescaling with nitrogen show a rise and an abrupt drop in rate below the point for that in air only. Scale growth and breakaway time are also less. The gas absorbed in the metal is confined to the outer layers, the depth depending on time, temperature and atmosphere. The temperature of greatest absorption is 900° C. (R2q, 2-12; Zr)

**215-R. Corrosion of Uranium-Zirconium Alloys in Water at Temperatures up to 100° C.** H. A. Pray and W. E. Berry. *U.S. Atomic Energy Commission,* BMI-893, Dec. 16, 1953, 26 p. (CMA)

Uranium with 5% Zr shows good corrosion resistance in water at 100° C. after exposure for one year if it is oil or water quenched from above 700° C. Subsequent annealing at 500 or 600° C. decreases the resistance, as do dissolved hydrogen-oxygen mixtures above 35:1. A nitric acid pickle overcomes the effects of abrasion damage and does not harm the corrosion resistance, nor does galvanic coupling with aluminum have a bad effect. Increasing zirconium beyond 7.5% eliminates the sensitivity to crevice effects and the dissolved hydrogen-oxygen ratio. (R4; U, *Zr*)

**216-R. Corrosion and Ignition of Titanium Alloys in Fuming Nitric Acid.** J. B. Rittenhouse, et al. Wright Air Development Center, Technical Report 56-414. *U.S. Office of Technical Services,* PB 121940, Feb. 1957, 67 p. (CMA)

Corrosion studies of titanium alloys stored in fuming $HNO_3$ covered ignition reactions and stress-corrosion cracking. The conditions of the $HNO_3$-$NO_2$-$H_2O$ system varied from 1 hr. to 90 days, 25 to 71° C., and liquid to vapor phase. Results of metallographic examinations of corroded samples are discussed and X-ray diffraction data reported.
(R6g; Ti)

**217-R.** (English.) **Kinetics of the Oxidation of Silicon Iron in Air at High Temperatures.** V. V. Ipatyev and G. M. Orlova. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 881-888. (Translated by Consultants Bureau Inc., 227 W. 17th St., New York 11, N. Y.)

Composition and structure of the scale on iron determines in some cases the rate of iron oxidation in various gaseous media (air, steam-hydrogen and steam-oxygen mixtures) at high temperatures. The influence of small additions of silicon to iron on the oxidation rate of the resulting alloy in air, and the effect of silicon on the composition and structure of the scale formed during oxidation. 7 ref.
(R1h, 1-12; Fe, *Si*)

**218-R.** (English.) **Oxidation of Chromium-Silicon Steels in Air at High Temperatures.** G. M. Orlova and V. V. Ipatyev. *Journal of Applied Chemistry of the USSR,* v. 29, June 1956, p. 889-897. (Translated by Consultants Bureau Inc., 227 W. 17th St., New York 11, N. Y.)

An investigation of the oxidation kinetics of 6% Cr steel containing

1.43, 1.86 and 3.34% Si in the temperature range 800-1200° C. Linear relation exists between log K (constant of reaction rate) and the reciprocal of the absolute temperature for all steels. 10 ref.
(R1h, 2-12; AY, *Cr*, Si)

**219-R.** (English.) **Method of Electrochemical Oxide Coating of Iron and Steel in Hot Concentrated Alkali Solution.** V. V. Losev. *Journal of Applied Chemistry of the USSR*, v. 29, June 1956, p. 1031-1032. (Translated by Consultants Bureau Inc., 227 W. 17th St., New York 11, N. Y.)

Brief review of electrochemical surface oxidation of iron and steel. 8 ref. (R1h; Fe, ST)

**220-R.** (French.) **Protection Against Corrosion of High-Tension Cables of Steel Tubing Under Fluid Pressure.** J. Changarnier and J. Rollin. *Corrosion et Anticorrosion*, v. 5, Jan. 1957, p. 2-9.

Technical and economic advantages of such underground cables; nature of cathodic protection and electrical equipment used; practical applications. (R8, R10d; ST, 4-10)

**221-R. Protective Sodium Benzoate Impregnated Jute Wrappings for Steel Parts.** T. H. Soutar. *Corrosion Prevention & Control*, v. 4, Feb. 1957, p. 47-49.

Polished steel shafting exposed for 12 months to chemistry laboratory atmosphere showed no corrosion when wrapped in impregnated jute. However, incorporation of wax in the impregnating solution was conducive to rusting. 3 ref. (R10f; ST)

**222-R. Prevention of Corrosion: Cathodic Protection of Iron and Steel Structures.** *Electrical Review*, v. 160, Mar. 15, 1957, p. 481-482.

Two means of applying cathodic protection: the "sacrificial-anode" and the "power-impressed" method. (R10d; ST)

**223-R. Corrosion of Mild Steel by Aqueous Ammonium Thiocyanate.** L. A. Ravald, J. W. Chilver and R. Williams. *Journal of Applied Chemistry*, v. 7, Mar. 1957, p. 113-117.

Mild steel was exposed at room temperature and in stagnant conditions to aqueous 1.0 *N* and 0.1 *N* ammonium thiocyanate at various pH values, to ascertain the respective pH ranges of uniform attack, localized attack and complete inhibition. For comparison, similar experiments were made with ammonium chloride and with ammonium sulphate. 4 ref. (R6j; CN)

**224-R. Anti-Corrosion Measures for Large Steel Pipelines.** R. Drake. *Pipes and Pipelines*, v. 1, Mar. 1957, p. 15-18.

Protection techniques for steel pipes which can insure resistance to corrosion under all normal operating conditions; pretreatments, internal protection, external protection and cathodic protection described. (R10; ST, 4-10)

**225-R. Corrosion Studies of Carbon Steel in Alkaline Pulping Liquors by the Potential-Time and Polarization-Curve Methods. Pt. II. Mixtures of White With Oxidized or Nonoxidized Black Liquor.** W. A. Mueller. *Tappi*, v. 40, Mar. 1957, p. 129-140.

Influence of secondary factors on the polarization curve, such as stirring, the formation of iron sulphide deposits on the electrodes, and duration of the experiment. 23 ref. (R7; CN)

**226-R. Studies of the Oxidation and Contamination Resistance of Binary Niobium Alloy.** T. Sims, William D. Klopp and Robert I. Jaffee. Battelle Memorial Institute. *U.S. Atomic Energy Commission*, BMI-1169, Feb. 19, 1957, 52 p.

Study of the effects of binary alloying additions on the oxidation and contamination resistance of columbium was conducted. Alloys contained up to 35 at. % titanium, chromium, and zirconium, 25 at. % vanadium, molybdenum, tantalum and tungsten, and 5 at. % beryllium, boron, cobalt, iron, manganese, nickel and silicon. The oxidation and contamination studies were conducted in air at 600, 800 and 1000° C. Contamination was investigated by hardness-penetration measurements on all oxidized alloys except those containing beryllium or boron. 8 ref. (R1h, 1-10; Cb)

**227-R.** (French.) **Research on Corrosion Produced by Alternating Currents.** Lucien Amy and Claude Mounios. *Revue Générale de l'Electricité*, v. 66, Mar. 1957, p. 187-188.

Laboratory experiments establish possibility of production of notable corrosion phenomena on metal piping by means of stray alternating currents of industrial frequency. (R1j; R11)

**228-R.** (German.) **Effect of Hydrogen Fluoride and Hydrofluoric Acid on Materials.** E. Lingnau. *Werkstoffe und Korrosion*, v. 8, Apr. 1957, p. 216-233.

Unalloyed steels, nickel, copper, silver and lead are resistant to hydrofluoric acids of moderate concentrations. Ingot steel is resistant even to acids of more than 65%. Aluminum and titanium are corroded by hydrofluoric acids of all concentrations though they are more or less resistant to dry hydrogen fluoride. 202 ref. (R6g)

**229-R.** (Italian.) **Deposits and Corrosiveness of Combustible Oils During Combustion: Measurements — Additives.** Maurizio Panetti. *Termotecnica*, v. 11, Mar. 1957, p. 127-132.

Ash deposits on metal and nonmetallic parts of heating equipment; methods of measuring corrosiveness of residual oils; available corrosion preventives. Attempts to establish, in case of a gas turbine, maximum percentages of harmful elements compatible with proper functioning of equipment: study limited to sodium, vanadium and sulphur. 8 ref. (R7d; RM-k)

**230-R.** (Japanese.) **Study of Corrosion Fatigue; Method of Measuring Damage Caused by Corrosion Fatigue.** Kanetoshi Iwamoto. *Japan Society of Mechanical Engineers, Transactions*, v. 23, Mar. 1957, p. 238-241.

After specimens were corroded with a water stream under various magnitudes of rotary bending stress and for various times, they were subjected to fatigue tests in air under a stress, which was about 20% larger than the fatigue limit of the material. (R1e, R11)

**231-R.** (Swedish.) **Scaling of 18-8 Stainless Steel in Reheating Furnace Atmospheres.** John Olof Edström. *Jernkontorets Annaler*, v. 141, no. 3, 1957, p. 105-145.

The structural pattern of oxide layers formed on 18-8 steel at 1050° C. in different types of atmosphere was studied by microscopic and X-ray diffraction methods. Special attention was paid to the microstructure of flaking and adherent oxide layers and to the influence of sulphur on the oxidation structures. 45 ref. (R2q, J2k; SS)

**232-R.** (Pamphlet.) **Corrosion Testing Methods, Monel, Inconel, Nickel and Nickel Alloys. Technical Bulletin T-10.** 17 p. Aug. 1956. International Nickel Co. Inc., 67 Wall St., New York 5, N. Y.

Discussion of laboratory tests, plant tests and service tests. (R11; Ni)

## Inspection and Control

**246-S. Determination of Thorium and Lanthanons in Monazite.** J. Clinch and E. A. Simpson. *Analyst*, v. 82, Apr. 1957, p. 258-269. (CMA)

Oxalic acid is shown to be unsatisfactory as a group precipitant for the lanthanons and thorium when they are determined in monazite because of solubility losses. These losses are reduced when the precipitant is ammonium oxalate. A double oxalate precipitation is followed by the precipitation of thorium as the benzoate and the precipitation of the lanthanons as hydroxides. The precision and coefficients of variation are discussed. (S11j; Th, EG-f)

**247-S. Spectrophotometric Determination of Copper in Titanium.** A. J. Frank, A. B. Goulston and A. A. Deacutis. *Analytical Chemistry*, v. 29, May 1957, p. 750-754. (CMA)

A procedure for determining copper in steel (chloroform-alcohol extraction of the cuprous neocuproine complex) has been successfully applied to copper in titanium. Copper is then estimated spectrophotometrically. Chromium is the only serious interference and may be eliminated by complexing Cr(III) with sulphite. The sulphuric-fluoboric procedure is cited as the best method of dissolving titanium; hydrolytic separation of titanium is unlikely. 16 ref. (S11a; Ti, *Cu*)

**248-S. Colorimetric and Gravimetric Determination of Silicon in Titanium and Titanium Alloys.** M. Codell and G. Norwitz. *Analytica Chimica Acta*, v. 16, Apr. 1957, p. 327-332. (CMA)

Errors in the "molybdenum blue" method of determining silicon in titanium alloys are discussed. Improved colorimetric and gravimetric methods are proposed. In the former the sample is dissolved in HF, $H_3BO_3$ is added and oxidation is effected with $H_2O_2$ and permaganate. Most of the titanium is precipitated by heating in boiling water and the "molybdenum blue" is developed at 23° C. and read spectrophotometrically. In the gravimetric method the sample is fumed with $H_2SO_4$, the silica is ignited and then fused with sodium carbonate. $HClO_4$ is used for dehydration. The colorimetric method is best up to 1.5% Si and the gravimetric down to 0.3% Si. (S11a, S11b; Ti, *Si*)

**249-S. Eddy Current Electrical Conductivity Measurement as an Analysis for Molybdenum in Binary Molybdenum-Uranium Alloys.** R. E. Cofield. *U.S. Atomic Energy Commission*, Y-1152, Feb. 15, 1957, 32 p. (CMA)

Following a discussion of the principles and problems involved in measuring the electrical conductivity of a solid by the eddy current method, the results of applying the method to determining molybdenum in

2% Mo uranium alloys are reported. Chemical and conductivity analyses were compared and agree well. It is necessary that the eddy current conductivity meter be calibrated by use of chemically analyzed test objects. Analyses are performed accurately in 1 min. or less. 47 ref. (S11g, P15g, 1-2; U, *Mo*)

**250-S. Prediction of X-Ray Absorption Characteristics of a U-Zr Alloy Fuel Element.** W. R. Plant. *U.S. Atomic Energy Commission,* KAPL-M-RCD-20, Apr. 26, 1957, 8 p. (CMA)

A study of the X-ray absorption of 41.75% Zr uranium fuel elements shows that inhomogeneities may be revealed by the radiographic process when densitometric methods are used. The limit of sensitivity appears to 0.5-0.8% when applied to a gradual change along the element. (S13e, T11g, 17-7; U. *Zr*)

**251-S.** (French.) **Fractionation of Rare Earths by Means of Ethylenediaminetetraacetic Acid.** G. Brunisholz. *Chimia,* v. 11, Apr. 18, 1957, p. 97. (CMA)

Ethylenediaminetetraacetic acid (E) and rare earths (R) form together complex anions (ER) whose alkali or ammonium salts (e.g., $NH_4$(ER) or K(ER)), crystallize with varying amounts of water of crystallization and in different, non-isomorphous forms. Accordingly, systems involving several rare earths will present gaps in the miscibility of solid phases. For such cases the phase theory offers the possibility of foreseeing successful fractionation cycles. Thus, from a mixture of rare earths of the cerium series containing 8.5 at. % Pr, 35% Nd, 8% Sa and 48.5% La the authors, using ammonium salts, obtained a first fraction of pyramidal crystals composed of 11 at. % Pr, 12% Nd, 11% Sa and 26% La, then a second fraction of needle-like crystals containing 6 at. % Pr, 12% Nd, 1% Sa and 81% La; the mother liquor was returned to the cycle. In a similar way mixtures of elements of the yttrium series can be fractionated by means of ammonium salts. 3 ref. (S11f; EG-g)

**252-S.** (German.) **Use of Complexones in Chemical Analysis. Pt. LI. Colorimetric Determination of Cerium in Magnesium Alloys.** M. Malinek and L. Klir. *Collection of Czecoslovak Chemical Communications,* v. 22, Feb. 1957, p. 319-322.

The presence of manganese interferes with the color effects of the known colorimetric methods for the determination of cerium. A color reaction of cerium is described which is not disturbed by the presence of manganese and can, therefore, be applied for a direct determination of cerium, not requiring its separation from manganese. It consists in an oxidation of tetravalent cerium with hydrogen peroxide in an ammonia solution and in the presence of complexone. While bivalent manganese remains bound to complexone, the oxided cerium forms a compound of a transient yellow-to-brown color that can be measured. 8 ref. (S11a; Mg, *Ce*)

**253-S.** (Russian.) **Determination of High-Dispersion Carbides of Vanadium, Molybdenum and Titanium.** N. M. Popova, A. F. Platonova, L. V. Zaslavskaya and M. F. Rybina. *Zavodskaya Laboratoriya,* v. 23, no. 3, 1957, p. 269-272. (CMA)

The usual procedure of separating carbides in steel by boiling steel chips in acids is not suitable for the case of highly dispersed carbides of vanadium, molybdenum and titanium, since they partially dissolve in acids. The authors developed procedures for determining such carbides in precipitates obtained by anodic dissolution of steel in Kel: (*a*) the precipitates are treated for several hours with boiling 0.5% hydrochloric acid, sometimes in the presence of alcohol (as a surface-active agent), whereby the high-dispersion phase becomes dissolved; (*b*) by boiling the precipitate in alcohol solution of hydrogen peroxide, cementite remains in the precipitate while special carbides dissolve. These methods were applied to the study of the problem of the secondary strengthening, acquired by steels through annealing and attributed to the formation of high dispersion carbides. A correlation between the degree of strengthening and the amount of such carbides was actually observed. 4 ref. (S11; ST, *V, Mo, Ti,* 14-18)

**254-S. Non-Destructive Testing in the Control of Quality of Non-Ferrous Castings.** S. L. Fay. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 361-366.

Briefly reviews visual inspection, liquid penetration, pressure testing, ultrasonic testing and fluoroscopy; gives detailed considerations to radiography; covers factors affecting quality of radiographs and radiographic procedure; discusses and illustrates defects revealed by method. (S13; EG-a, 5)

**255-S. An Improved Method for the Simultaneous Determination of Aluminium, Copper and Magnesium in Zinc Alloys by Spectrographic Method.** B. C. Kar, M. K. Gupta and V. Muthukrishnan. *Journal of Scientific and Industrial Research,* v. 16B, Jan. 1957, p. 27-31.

An improved spectrographic method which employs the porous cup-spark technique and the plate calibration method is described for the simultaneous determination of aluminum, copper and magnesium in zinc-base alloys. The method is speedy and the elements were determined with an accuracy of 3%. 9 ref. (S11k; Zn, *Al, Cu, Mg*)

**256-S. Use of Atomic Energy in the Testing of Materials.** W .M. Keller. *Mechanical Engineering,* v. 79, Mar. 1957, p. 258-260.

Inexpensive radiosotopes offer possibilities for nondestructive inspection. Possibilities in railroad testing are discussed. (S general; 14-13)

**257-S. Applications of Nondestructive Testing to Fuel Elements for Nuclear Reactors.** W. J. McGonnagle and E. C. Wood. *Nondestructive Testing,* v. 15, Mar-Apr. 1957, p. 86-90.

Applications of various nondestructive tests to check bond integrity, weld integrity, tubing, clad thickness, and grain size and orientation in the fuel elements of nuclear reactors are discussed. The isothermal frost test is described in detail. (S13, S14, M27c, T11g)

**258-S. Inspection of Small-Diameter Tubing by Eddy-Current Methods.** J. W. Allen and R. B. Oliver. *Nondestructive Testing,* v. 15, Mar-Apr. 1957, p. 104-109.

What can be accomplished with eddy-current tests on nonferromagnetic small-diameter tubing according to present-day methods and what may be expected in the near future. (S13c; 4-10)

**259-S. An Evaluation of the Application of Thulium-170 to Industrial Radiography.** James W. Dutli and Dana Elliott. *Nondestructive Testing,* v. 15, Mar-Apr. 1957, p. 112-114.

Thulium-170 is suitable for radiography of very thin metal sections. The light weight and the compactness of the unit should make it applicable in many cases where X-ray generators cannot be used because of space limitations or economy. (S13e, 1-3; Tm, 14-13)

**260-S. Fatigue Strength of Bolts Reduced by Longitudinal Flaws.** Joseph Viglione. *Product Engineering,* v. 28, Mar. 1957, p. 203-205.

Longitudinal flaws which are difficult to find and are not readily visible may be important as a source of failure. Circular magnetization is used for detection. (S13h, Q7a, T7f, 17-7)

**261-S. Spectrophotometric Estimation of Uranium With Tiron.** B. Sarma and C. P. Savariar. *Scientific and Industrial Research, Journal,* v. 16B, Feb. 1957, p. 80-82.

A spectrophotometric method for the estimation of semi-micro quantities of uranium up to 400 ppm. Uranium forms a highly soluble brown complex with tiron (disodium cathechol disulphonate.) 5 ref. (S11a; U)

**262-S. Tantalum Determination.** R. W. Moshier and J. E. Schwarberg. Wright Air Development Center, Technical Report 56-300. *U.S. Office of Technical Services,* PB 121819, June 1956. 39 p. (CMA)

A schedule for analysis of mixtures containing titanium, zirconium, columbium, tantalum, molybdenum and tungsten has been developed, and the separation of the first four from the latter two metals has been improved. A reagent has been developed for separating tantalum from titanium and zirconium. (S11f; Ta, Ti, Zr)

**263-S.** (English.) **Polarographic Determination of Arsenic in Lead Metal.** Hidehiro Goto and Shigero Ikeda. *Tohoku University, Science Reports of the Research Institutes.* v. 9-A, Apr. 1957, p. 91-96.

Polarographic studies of arsenic in various supporting electrolytes were made and the method for the polarographic determination of arsenic was established. Polarographic determination of 0.003 to 0.1% arsenic in lead could be made. (S11m; Pb, *As*)

**264-S.** (English.) **Polarographic Determination of Tin and Antimony in Iron and Steel.** Hidehiro Goto, Shigero Ikeda and Shiro Watanabe. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 97-106.

For the estimation by polarography of small amounts of tin and antimony contained at impurities in iron and steel, it was necessary to eliminate the effect of interference of iron. These impurities were, therefore, separated from iron by coprecipitating with manganese dioxide. 0.02 to 0.1% tin and 0.005 to 0.1% antimony in iron and steel could be determined. (S11m; Fe, ST, *Sn, Sb*)

**265-S.** (English.) **Electrolytic Determination of Lead in Iron and Steel.**

Hidehiro Goto and Yachiyo Kakita. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 131-137.

Studies were made on the application of electrolytic deposition of lead as lead dioxide for the determination of lead in iron and steel. The influences of some diverse ions were also investigated and a suitable procedure for the routine analysis of iron and steel was established. (S11; Fe, ST, *Pb*)

**266-S.** (English.) **Determination of Micro-Amounts of Calcium, Magnesium and Aluminium in Titanium Metal.** Hidehiro Goto and Shuro Takeyama. *Tohoku University, Science Reports of the Research Institutes,* v. 9-A, Apr. 1957, p. 138-146.

Satisfactory results were obtained by extracting titanous thiocyanate with ether. Photometric determination was carried out after separation by using chlorophenol azodihydroxynaphthalenesulfonate for calcium, titan yellow for magnesium and extraction of the oxine for aluminum. (S11a; Ti, *Ca, Mg, Al*)

**267-S.** (French.) **Sampling for the Determination of Hydrogen Content of Steel and Cast Iron.** E. Piper and H. Hagedorn. *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 329-333.

Test sampling and method adopted for detecting hydrogen and measuring its quantity. Comparison of three methods of taking samples. (S12h, S11; ST, CI, *H*)

**268-S.** (French.) **Sensitometric Determination of the Best Conditions for Use of Radioactive Sources in the Gamma-Ray Examination of Steel.** H. De Leiris and E. Antoni. *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 83-92.

Through the methodical measurement of the extent of darkening under varying conditions it is possible to work out exposure formulas which, represented on charts, give the time of exposure involved in particular cases. By comparison of these formulae, various emulsions are classified to be used as a guide for the selection of an emulsion as a function of the type of inspection to be made. The image quality indicator makes it possible to determine the best conditions governing the use of radioactive sources in relation to steel thickness. 3 ref. (S13e, 1-3; ST)

**269-S.** (Swedish.) **Sampling Methods for Hydrogen Determination in Steel.** Lars Bjerkerud. *Jernkontorets Annaler,* v. 141, no. 2, 1957, p. 94-99.

Samples taken from both ladles and molds; analyses on ground and unground specimens compared. (S12h; ST, *H*)

**270-S. Polarographic Determination of Arsenic in Zinc-Smelting Residuals and Zinc Metal.** R. E. Coulson. *Analyst,* v. 82, Mar. 1957, p. 161-164.

A simple method developed for the determination of 0.1 to 5% of arsenic in residuals arising from the production of zinc from sulphide ores. 3 ref. (S11m; Zn, *As*)

**271-S. Determination of Uranium by Ammonium Thiosulphate and Sodium Hypophosphite.** H. N. Ray and N. P. Bhattacharayya. *Analyst,* v. 82, Mar. 1957, p. 164-166.

Uranium is determined gravimetrically by precipitation as the greenish phosphate from dilute mineral-acid solution by means of sodium hypophosphite and ammonium thiosulphate. The method has been successfully applied to the determination of uranium in steel. 4 ref. (S11b; ST, *U*)

**272-S. Photometric Determination of Arsenic and Phosphorus in Copper-Base Alloys.** H. C. Baghurst and V. J. Norman. *Analytical Chemistry,* v. 29, May 1957, p. 778-782.

Determination of arsenic by the formation of a mixed heteropoly acid with molybdenum and vanadium; the factors influencing formation of the complex were examined, and conditions designed to give results independent of temperature from 17 to 35° C. were established. Method was then extended to permit simultaneous determination of both arsenic and phosphorus in deoxidized copper without prior separation. 6 ref. (S11a; Cu, *As, P*)

**273-S. Thermolysis of Thorium Precipitates. Salts of Organic Acids.** Wesley W. Wendlandt. *Analytical Chemistry,* v. 29, May 1957, p. 800-802.

Thermal decomposition of the thorium precipitates with stearic, pyrogallic, m-hydroxybenzoic, m-cresoxy-acetic, benzoic, 2,4-dichlorophenoxy-acetic, phenylacetic, cinnamic, and oaminobenzoic acids and mercapto-thiazole were studied on the thermo-balance. 13 ref. (S11b; Th)

**474-S. Spectrophotometric Determination of Tungsten in Tantalum, Titanium, and Zirconium Using Dithiol.** P. Green. *Analytical Chemistry,* v. 29, June 1957, p. 896-898. (CMA)

Tungsten may be determined in titanium, zirconium and tantalum as the dithiol complex. The blue-green color is retained through the extraction with amyl acetate and measured spectrophotometrically. The samples are dissolved with HF-$HNO_3$. Molybdenum can be extracted sequentially before tungsten by dithiol using 4N HCl and $SnCl_2$; the reductant for tungsten is $TiCl_3$. (S11a; Ta, Ti, Zr, *W*)

**275-S. Determination of Zirconium in Steel. Direct Spectrophotometric Method.** R. B. Hahn and J. L. Johnson. *Analytical Chemistry,* v. 29, June 1957, p. 902-903. (CMA)

Small amounts of zirconium in steels may be determined by spectrophotometric measurement of the absorbance of the chloranilate at 330 mμ (for amounts under 0.1%) or 525 mμ. Interfering ions are removed by electrolysis with a mercury cathode. The results agree well with those from the methods using p-dimethylaminoazobenzenearsonic acid and mandelic acid. 10 ref. (S11k; ST, *Zr*)

**276-S. Thoron-Meso-Tartaric Acid System for Determination of Thorium.** M. H. Fletcher, F.S.E. Grimaldi and L. B. Jenkins. *Analytical Chemistry,* v. 29, June 1957, p. 963-967. (CMA)

The thoron determination of thorium in zircon and zircon-containing minerals is simplified by masking zirconium with meso-tartaric acid. A study of the variables covers reagent concentrations, temperature, diverse ion effects and time. The substitution of meso-tartaric acid for d-tartaric acid permits a direct spectrophotometric determination of thorium. A dilution procedure is given. (S11; Th)

**277-S. Application of Non-Destructive Testing to Castings.** C. W. H. du Toit. *Engineer and Foundryman,* v. 21, Feb. 1957, p. 58-63.

Nondestructive testing for gas holes, gas porosity, shrinkage, heterogeneities. (S13; 5, 9-18)

**278-S. "Autosonics" Flaw Detection. Continuous-Scan Ultrasonic Inspection.** *Engineering,* v. 183, Mar. 22, 1957.

Gap-spanning installation for the automatic detection of lamination in steel plate. (S13g; ST)

**279-S. Detection of Internal Flaws in Rails by Ultrasonic Methods.** Jean Palme. *Inspection Engineer,* v. 20, July-Aug. 1956, p. 86-89.

Principles of ultrasonic inspection, operation of equipment and the reliability of tests. (S13g, 1-2, T23q)

**280-S. Inspection of Drop Forgings.** H. J. Merchant. *Inspection Engineer,* v. 20, Nov-Dec. 1956, p. 129-133.

Brief statement on inspection of drop forgings from an engineering viewpoint, including preliminary, processing and final inspection. Highly integrated with these is the inspection of drop forgings from a metallurgical viewpoint which comprises material acceptance, maintenance of material identity, maintenance of correct standards of mechanical manipulation and thermal treatment and the mechanical testing of the forged product. (S general, F22n)

**281-S. Destructive and Non-Destructive Testing.** F. T. Galton. *Inspection Engineer,* v. 21, Jan-Feb. 1957, p. 10-14.

Types of tests defined and described. (S general, Q general)

**282-S. Development of Methods for the Chemical Determination of Uranium.** T. W. Steele. *South African Institute of Mining and Metallurgy, Journal,* v. 57, Nov. 1956, p. 144-152.

Analytical methods evaluated by the South African Government Metallurgical Laboratory. 12 ref. (S11; U)

**283-S. Determination of Uranium Dioxide in Stainless Steels by the X-Ray Fluorescence Method.** Louis Silverman, William W. Houk and Lavada A. Moudy. Atomics International, *U.S. Atomic Energy Commission,* NAA-SR-1848, Apr. 15, 1957, 11 p.

A rapid method using strontium as internal standard. 6 ref. (S11p; SS, *U*)

**284-S.** (Czech.) **Use of Ultrasonics in Testing of Large Forgings.** Vladimir Koblovsky. *Hutnické Listy,* v. 12, Apr. 1957, p. 302-309.

In ultrasonic testing there occur cases when the actual prescribed tests are satisfactory, but indications of ultrasonic testing show the presence of hidden defects. This is shown on forgings of three rotors, which were rejected at the works, and afterwards examined in detail to confirm the ultrasonic indications. 6 ref. (S13g; ST, 4-1)

**285-S.** (Czech.) **Ultrasonic Tests of Turbine and Generator Rotors.** K. Slonek. *Materialovy Sbornik,* 1956, p. 157-168.

Describes the testing device, the testing methods and the results of ultrasonic tests made on turbine and generator rotors; results show that it is possible to detect every serious defect inside the rotor (holes not closed by forging, inclusions, cracks and flaky spots). 6 ref. (S13g, T7h; 1-3)

**286-S.** (French.) **Definition and Control of the Quality of a Metal.** Marcel

Prot. *Courrier de la Normalisation,* v. 24, Feb. 1956, p. 45-48.

French Standards Association issues three specifications concerning quality, quality control and inspection. Comments on responsibilities of suppliers, tests by buyers and miscellaneous problems of quality control. (S22)

**287-S.** (Japanese.) **Quantitative Determination of Zinc in Zinc Ore by Disodium Ethylenediaminetetra-Acetate. (EDTA).** Ato, Kisei Tanahashi and Isamu Watanabe. *Kagah Kenkyusho Hokoku,* v. 33, Jan. 1957, p. 24-33.

Procedures; effect of ammonium chloride, and silicic acid.
(S11; Zn, RM-n)

## Metal Products and Parts

**138-T. Titanium in the Aircraft Industry.** *Aircraft Engineering,* v. 29, Apr. 1957, p. 113-122. (CMA)

Imperial Chemical Industries called a conference of representatives of the British Government and aircraft industry. Industrial statistics were quoted. The wrought titanium forms available to the aircraft industry were described and considered. Among the discussion subjects covered were stress specifications, formability, scrap reclamation, fatigue in titanium tubes, and development of high-strength sheet alloys. British sales of titanium are analyzed. (T24, A general; Ti)

**139-T. Clad Steels—Their Applications in Industrial Steel.** W. E. Mullestein. *Cornell Engineer,* v. 22, Mar. 1957, p. 11-14, 36.

Designing, advantages and uses of clad steels for industry.
(T general; ST, 8-16)

**140-T. Titanium Used for Breech of Bomb Ejector Rack.** E. A. Strate, H. A. Reesing and P. D. Goldberg. *Materials and Methods,* v. 45, May 1957, p. 158-159. (CMA)

Ti-6Al-4V is used in the breech part of bomb ejector racks for aircraft. The breech has an irregular shape and several functions. Stainless steel breeches showed heat checking and failed. The titanium breech is produced as an open die forging at 1720° F., annealed at 1300° F. for 2 hr., and furnace and air-cooled. After scale removal, the forging is heat treated at 1700° F. for 1 hr., water-quenched and aged for 3 hr. at 1000° F. Mechanical properties are tabulated. The titanium breech withstood 300 firings without heat checking.
(T2k, 17-7, J general; Ti)

**141-T. Titanium Used in Jet Slat Track to Reduce Weight, Inertia.** H. A. Reesing, J. G. Quinn and P. D. Goldberg. *Materials and Methods,* v. 45, May 1957, p. 172-173. (CMA)

Ti-6Al-4V was used as the material in jet slat tracks for the A3D Skywarrior to reduce weight and inertia and to eliminate magnetic effects on the compass. Ti-6Al-4V was chosen because of its availability, response to heat treatment and low hydrogen embrittlement. Plating problems are eliminated and weight savings are valued at $50 per lb. (T24, 17-7; Ti)

**142-T. Titanium in Modern Industry.** *Mechanical World,* v. 137, May 1957, p. 221-222. (CMA)

The role of titanium in the chemical processing industry is increasing. The metal is now used for acid tanks and tubes for condensers and heat exchangers. Recommendations are given for the forging, drawing, machining and grinding of titanium. Using sharp tools and minimizing frictional heat are stressed. Carbide tools are not best for intermittent machining. Melting titanium is described. Titanium carbide is a good tool material where heat is excessive. The use of titanium carbide in jet engines is noted.
(T29, 17-7, G general; Ti)

**143-T. Fabrication of Zircaloy Clad Fuel Plate Assemblies for Pressurized Water Reactors.** C. A. Meyers and E. D. Baugh. *U.S. Atomic Energy Commission,* WATD-T-326(DEL), Apr. 1956, 10 p. (CMA)

The pressurized water reactor seed consists of an annular ring of enriched fuel plate clusters in a matrix of blanket clusters. The subassemblies of the fuel plates are arranged and welded in a certain configuration and are Zircaloy-clad. Each subassembly is fabricated by heliarc welding first and fusion welding afterward with the aid of a welding box filled with helium. The subassemblies are annealed after cooling. (T11g, 17-7, K1d; U, *Zr*, 8-16)

**144-T. Structural Steels for Warship Building With Some Notes on Brittle Fracture.** Victor Shepard. *Engineer,* v. 203, Apr. 5, 1957, p. 526-527.

The special problems in the hull strength of surface warships and submarines, with reference to the theoretical and experimental research work being undertaken. Special emphasis is given to the work on steel materials, welding and brittle fracture, the object being to avoid brittle fracture in normal structural steels and the development of high-yield steels. Development difficulties are discussed, including welding problems.
(T22g, Q26s, K general; ST)

**145-T. Cutting Tools of Ceramic Oxide in Place of Sintered Hard Metal.** J. Hinnueber. *Industrial Diamond Review,* v. 17, Mar. 1957, p. 50-53.

Comparative properties of aluminum oxide and hard metals.
(T6n, 17-7; 6-20)

**146-T. Development of Niobium.** A. B. McIntosh. *Institute of Metals, Journal,* v. 85, Apr. 1957, p. 367-372.

Columbium's properties suggest use as canning material for nuclear reactors; data on chemical, physical and mechanical properties indicate potentialities of use as structural materials for liquid metal, heat transfer units or chemical processing equipment, electrical equipment; discussion of binary columbium alloy systems. 19 ref.
(T11, T29, Ti, 17-7; Cb)

**147-T. Metallurgy of Cutting Tools. Pt. 8. Improving Wear Resistance.** K. G. Lewis. *Iron and Coal Trades Review,* v. 174, Mar. 29, 1957, p. 745-747.

Methods claimed to effect improvement in tool life by reducing surface friction. General properties of cemented carbides considered.
(T6n, G17; SGA-j, 6-19)

**148-T. Metallurgy of Cutting Tools. Pt. 9. Design, Application, and Limitations of Cemented Carbides.** K. G. Lewis. *Iron and Coal Trades Review,* v. 174, Apr. 5, 1957, p. 801-803.

Problems in the use of cemented carbide tools. Methods of grinding, brazing, shrink fitting and the mechanical holding of these tools.
(T6n, G17, 17-7; SGA-j, 6-19)

**149-T. Quality-Control of Foil for Packaging.** *Packaging Review,* v. 77, Apr. 1957, p. 52-56.

Accurate methods of quality control in the production of aluminum foil have been largely responsible for the success of foil as a packaging material. Raw material testing; experimental coating, rolling; climate and temperature effect.
(T10g, 17-7; Al)

**150-T. Aluminum-Sheathed Cable: A Utilization Wiring System for Industrial and Domestic Distribution Which Is Being Used Extensively in Canada.** Philip J. Croft. *Power Apparatus and Systems,* v. 28, Feb. 1957, p. 1525-1534.

Evaluation of a system of utilization of wiring for industrial, commercial and domestic buildings based on the use of aluminum-sheathed insulated cable and fittings. 9 ref. (T1b, 17-7; Al)

**151-T. Redesigning Castings to Weldments.** Omer W. Blodgett. *Product Engineering,* v. 28, Mar. 1957, p. 135-139.

Factors influencing strength, rigidity, weight and cost of machine components produced by steel weldment. Analysis of vibration and noise problems. (T7, 17-7; ST, 7-1)

**152-T. Gaseous Contamination of Zircaloy-2 Cladding During Fuel Rod Fabrication by Extrusion and Drawing.** H. J. Snyder. *U.S. Atomic Energy Commission,* WAPD-FE-894, June 30, 1955, 7 p. (CMA)

Hydrogen, oxygen and nitrogen analyses were made of the Zircaloy-2 cladding of fuel rods before and after extrusion, after cold drawing and after nitric acid pickling. Analyses show that there is no gaseous contamination from the fabrication process.
(T11g, 17-7, G5, G4; Zr, EG-m)

**153-T.** (French.) **Research on Ni-Cr and Ni-Cr-Co Alloys for Turbo Reactor Blades. Their Practical Implications.** J. Poulignier. *Revue de Nickel,* v. 23, Jan-Feb-Mar. 1957, p. 1-8.

Analysis of properties demanded by turbo reactor application; post-service examination of defects and fissures by metallic and micrographic methods. (To be continued.) 11 ref. (T7h, 17-7; SS, Ni, *Cr, Co,* 9)

**154-T.** (French.) **Development of Special Nickel Steels for Underground Equipment of the Lorraine Iron Mines.** E. Majois. *Revue de Nickel,* v. 23, Jan-Feb-Mar. 1957, p. 9-12.

Advantages and economies in cost and space resulting from the use of nickel steels (Ni-Cr-Mo and Ni-Cr) in loading and transport equipment and maintenance machinery. Describes AFNOR 35-NCD-14 of high nickel content now in extensive use and possessing superior mechanical characteristics.
(T28r, 17-7; AY, *Ni, Cr*)

**155-T.** (French.) **Pressure Vessel Design.** *Soudage et Techniques Connexes,* v. 11, Mar-Apr. 1957, p. 101-109.

Reasons why a pressure vessel might prove unstable and precautions to be taken. In the calculation of thicknesses account should be

taken of a "design stress" determined from the properties of the materials used. Basis for the determination and calculation of this stress for mild and low alloy steel, as a function of service temperatures. Examination of creep curves and yield points for various steels. Precautions which guarantee complete safety.
(T26q, 17-7, Q25, 17-1, CN, AY)

**156-T.** (German.) **Materials for Airplane Jet Engines.** R. Krause. *Metall,* v. 11, Apr. 1957, p. 298-301.

Heat resistivity of the alloys Ti-5Cr-3Al and Ti-6Al-4V and their application for different parts of jet engines. Application of ferritic, ferritic-pearlitic and martensitic instead of austenitic steels for condensers, shafts and other jet engine parts.
(T24b, Q general, 2-12, 17-7; Ti, AY)

**157-T.** (Italian.) **Use of Aluminum in Agusta-Bell Model 47-G Helicopter.** *Alluminio,* v. 26, Mar. 1957, p. 112-115.

Italian firm manufacturing under Bell license makes helicopters for civilian and military use having numerous light alloy structural and mechanical parts. (T24, 17-7; Al)

**158-T. Metallurgy of Cutting Tools. Pt. VI. Ceramics and Steels.** K. G. Lewis. *Iron and Coal Trades Review,* v. 174, Mar. 15, 1957, p. 623-626.

Use of ceramics for cutting tools; preparation and machining of steel cutting tools; various types of tool-steel. 22 ref.
(T6n; 17-7; TS, SGA-j, 6-20)

**159-T. Metallurgy of Cutting Tools. Pt. VII. Medium Alloy and High-Speed Steels.** K. G. Lewis. *Iron and Coal Trades Review,* v. 174, Mar. 22, 1957, p. 689-692.

Medium alloy and high speed steels of various chemical compositions and heat treatments for use as cutting tools.
(T6n, 17-7; TS-m)

**160-T. Properties of Tellurium-Alloy Lead Sheath for Power Cable.** H. A. Hoover. *Power Apparatus and Systems,* v. 28, Feb. 1957, p. 1517-1525.

Tellurium-alloy lead for power cable; tensile properties, fatigue tests, corrosion tests, creep tests and aging stability. 18 ref.
(T1b, 17-7, Q general; Te)

**161-T. Atomic Power Development Associates Progress Report.** R. Evans, L. Minnick, A. Boltax and R. Duncan. Nuclear Metals, Inc. *U.S. Atomic Energy Commission,* NMI-1148, Dec. 31, 1955, 30 p.

Fabrication of a fuel element using casting and forging techniques. The primary purpose was to develop a method of casting an element which contained suitable coolant passages from one of two alloys—uranium with 5% Cr (eutectic) and uranium with 2% Zr. This element was typed a "radiator" element and contained tubing 0.165 in. O.D., spaced 0.195 in. on centers.
(T11g; U, *Cr, Zr*)

**162-T. Evaluation of Porous Materials for Boundary-Layer Control.** D. E. Debau. Battelle Memorial Institute. (Wright Air Development Center.) *U.S. Office of Technical Services,* PB 121851, Nov. 1956, 160 p. $4.

Criteria for comparing various commercial permeable sheet materials for use in boundary-layer control associated with high-lift systems. Fibrous and perforated materials, sintered powdered metals, and woven wire mesh.
(T24, 17-7; 6-21)

**163-T.** (Czech.) **Operation Results of the New Economical and Heat Resisting Alloy Fe-Al Type Pyroferal and Suggestions for Its Application.** Miloslav Vyklicky. *Materialovy Sbornik,* 1956, p. 141-155.

A survey of operating tests made with machine parts cast from Pyroferal: blades for pyrite furnaces; crucibles for cementation, for aluminum, borax and bronze; grate bars for steam boilers. Based on laboratory and operating tests, a general view is given of future application of Pyroferal to various machine parts. 7 ref.
(T7, 17-7; SGA-h, Fe, Al)

**164-T.** (German.) **New Developments in Aluminum-Tin Alloys.** E. S. Hedges. *Aluminium,* v. 33, May 1957, p. 318-322.

Aluminum-tin-base bearing metals combine the good running properties of tin-base metals with the high endurance of leaded bronzes and can be fitted to unhardened steel shafts. However, the metal must be treated to produce the finest possible grain. (T7d, 17-7; Sn, Al)

**165-T.** (German.) **Reliability of Aluminum Cables.** W. Zwehl. *Aluminium,* v. 33, May 1957, p. 322-324.

Advantages of aluminum for cable sheaths and conductors.
(T1b, 17-7; Al)

**166-T.** (German.) **Flexibility of Aluminum Cable Sheaths.** K. H. Hahne. *Aluminium,* v. 33, May 1957, p. 325-331.

Functions of the sheath of an electrical cable; brief account of the development of aluminum cable sheaths. (T1b, 17-7; Al)

**167-T.** (Italian.) **Selection, Use and Preparation of Hard Alloy Tipped Tools.** Piero Lovati. *Macchine,* v. 11, March 1957, p. 215-222.

Selection of lathe tools, nature of hard alloy tips; methods of brazing tips; mounting of tools to produce desired cuts; life of such tools, cooling after use, grinding.
(T6n, 17-7; W25)

**168-T.** (Italian.) **Savings Through Proper Design and Specifications of Helical Springs.** Alberto Oreffice. *Macchine,* v. 12, Apr. 1957, p. 397-399.

Cost and tolerance tables for various types of steel wire. Examples of improved design, such as change from music wire to chromium-vanadium alloy for spring for aircraft fuel pump when music wire was found to have excessive play caused by high ambient temperature. (T7c, 17-7; ST, AY, 4-11)

## W Plant Equipment

**190-W. Powdered Graphite Molds Simplify Titanium Casting.** A. L. Feild and R. E. Edelman. *Modern Castings,* v. 31, May 1957, p. 64-68. (CMA)

Complex titanium shapes can be cast in a graphite powder mixture which can be formed into a mold or core with conventional equipment; the cost is much less than with machined graphite molds. The results of a titanium casting study at Battelle, using approved furnace techniques, are reported. The optimum composition was 53% graphite powder, 10% cornstarch, 10% pulverized pitch, 8% carbonaceous cement, 1% surfactant and 18% water. The starch furnishes green strength and the pitch and cement form a solid, high-temperature bond when the mold is fired. Casting a valve body is discussed as an example. No reaction of the casting with the mold was revealed. Further reduction in the amount of water used is desirable.
(W19g, 1-2; Ti, NM-k 36)

**191-W. Vacuum Arc Melting Furnace for Refractory Metals.** O. Z. Rylski and H. V. Kinsey. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 69-76.

Permits use of consumable or non-consumable electrode. Adaptable for either low-pressure melting with continuous evacuation of gases, or melting in argon with pressures up to or slightly higher than one atmosphere. (W18s, 1-23, 1-2)

**192-W. A Pilot-Model, Three-Phase, A.C. Consumable-Electrode Furnace.** P. C. Magnusson, G. L. Schmidt, F. Caputo and R. A. Beall. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 77-86.

Yields a billet-shaped ingot suitable for direct rolling. The three electrodes are placed in line and power supply connected in wye.
(W18s, 1-2)

**193-W. Electrode Control Systems for Inert Atmosphere and Vacuum Arc Furnaces.** E. J. Borrebach. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 87-96.

Operating characteristics and relative merits of electronic, electromechanical, rotary regulator and magnetic amplifier controls.
(W18s, X10, 1-2, 1-23)

**194-W. The High Intensity Arc: Electrode Requirements for Metallurgical Application.** Samuel Korman and Charles Sheer. Paper from "Arcs in Inert Atmospheres and Vacuum", Electrochemical Society. (John Wiley & Sons, Inc.), p. 184-188.

Problems in electrode fabrication as regards ore-carbon ratio. 1 ref.
(W18s, T1f, 17-7)

**195-W. Chemical Aspects of Nuclear Power. I—Chemistry and Metallurgy.** F. S. Martin. *Atomics and Nuclear Energy,* v. 8, Apr. 1957, p. 127-130, 147.

In the program of nuclear power, joint collaboration between chemists and metallurgists has been vitally necessary for the design of components and study of the behavior of materials. Some of these important aspects are dealt with.
(W11p, 17-7)

**196-W. Modern Hot Blast Stove Charging Equipment.** Herman Jansen. *British Steelmaker,* v. 23, Apr. 1957, p. 104-109.

Illustrates arrangement and describes operation of burner shut-off valves, hot blast valves, pressure relief valves, chimney valves and equipment for central control of blast furnace stoves.
(W17g, X12b, 1-2; Fe)

**197-W. Fume Exhaustion in the Plating and Allied Industries.** D. J. Fishlock. *Electroplating and Metal Finishing,* v. 10, Apr. 1957, p. 103-108.

Different types of exhaust equipment for fume-evolving finishing processes. (To be continued.)
(W13c, L17, 1-2)

**198-W. Vertical Casting Wheel Now in Full Production at Utah Copper Refinery.** *Engineering and Mining Journal,* v. 158, Apr. 1957, p. 75-77.

Brief descriptions of design features of vertical casting wheel which permits automatic casting of cakes up to 3200 lb. in weight.
(W19f, 1-2; Cu)

**199-W. Blast Furnaces in Czechoslovakia. Construction of Thin-Walled Furnaces.** S. Chernov. *Iron and Coal Trades Review,* v. 174, Mar. 29, 1957, p. 741-743. (Summary of a Russian article in *Stal'*).

About half the blast furnaces in use in Czechoslovakia are of thin-walled construction, with a brickwork lining of a thickness of 150 to 250 min. (6 to 10 in.). Experience with such furnaces has shown that they are suitable for the smelting of various grades of iron, and in long-term reconstruction plans it is proposed to replace most of the present blast furnaces in Czechoslovakia by thin-walled units.
(W17g, 1-2; Fe, RM-h)

**200-W.** (German.) **Anodes for Chromium Baths.** Günter Dehmel. *Metallwaren-Industrie und Galvanotechnik,* v. 48, Apr. 1957, p. 153-156, 164.

Lead alloyed with antimony, silver, or a specially developed alloy "Chromin", results in the most satisfactory anodes. 8 ref.
(W3h, 17-7; Pb, *Sb, Ag, Cr*)

**201-W. Design Features of High-Frequency Hardening Machines.** Karl Belling and Hans-Karl Sehler. *AEG Progress,* no. 3, 1956, p. 205-210.

By the use of induction hardening machines surface hardening may be carried out with an assurance of the best possible results as regards quality and performance. Principles are indicated, which are applicable to the design of machines for their particular function. Correct operation is insured by automatic features and electrical regulating devices. Typical examples of machines for various purposes.
(W27k, 1-2)

**202-W. Iron Powder Improves the Weld Complexion.** Reid Ellenor. *Canadian Machinery and Manufacturing News,* v. 68, Apr. 1957, p. 173-178.

Rules for selecting electrodes; advantages of iron powder electrodes.
(W29h, 17-7; Fe)

**203-W. Use of Liquid Metals in Atomic Reactors.** J. B. Lewis. *Discovery,* v. 17, Nov. 1956, p. 469-472.

Problems of sodium-graphite reactor; Dounreay fast breeder reactor; and liquid metal fueled reactor. (W11p, 17-7; 14-10)

**204-W. New Semi-Continuous Hot-Strip Mill in Belgium.** *Iron and Coal Trades Review,* v. 174, Mar. 22, 1957, p. 673-674, 672.

Short survey of mills in Belgium; description of a new strip mill.
(W23c, 1-2, 1-11)

**205-W. Today's Challenge of Nuclear Corrosion.** Robert F. Koenig. *Power,* v. 101, Apr. 1957, p. 80, 81, 180, 182, 184.

Selection of corrosion-resistant metals for pressurized-water reactors. (W11p, 17-7, R general)

**206-W. Production of Corrosion Resistant Steel Castings for the Uranium Industry.** W. G. Boustred. *South African Mechanical Engineer,* v. 6, Jan. 1957, p. 199-205.

Types of alloys manufactured, nature of castings manufactured, melting techniques, heat treatment and machining of the castings.
(W11p, 17-7, SGA-g, 5)

**207-W.** (French.) **Aligned Point Nomograms for Calculations Dealing With Electrolytic Aluminum Furnaces.** Louis Ferrand. *Revue Générale de l'Electricité,* v. 66, Feb. 1957, p. 111-123.

Operating and structural parameters of these furnaces, particularly those pertaining to dimensions of anodes and of the crucible surrounding the latter. (W18e, 1-2; Al)

**208-W.** (German.) **Lances With Explosive Charge (Jet Tappers for Opening the Tapholes of Openhearth Furnaces) Pt. I. Design and Mode of Action of the Shooting Lance.** Josef Prior. *Stahl und Eisen,* v. 77, May 2, 1957, p. 562-563.

Description of the model received from the U.S.A.; mode of action of the hollow charge and of the copper insert; effect of the hollow charge in opening the tapholes of openhearth furnaces.
(W18r, 1-22, D9n; ST)

**209-W.** (German.) **Opening the Tapholes of Openhearth Furnaces by Means of Lances with Explosive Charge (Jet Tappers) Pt. II.** Werner Burmeister. *Stahl und Eisen,* v. 77, May 2, 1957, p. 563-567.

Description of the parts of the lance and operation of the second melter; introduction of the lance into the pouring spout after preboring. Technical advantages of the new method; increased speed, safety and economy; cost problem; effect of the size of the furnace on the economic efficiency of the new method. (W18r, 1-22, D9n; ST)

**210-W.** (German.) **Design and Performance of Hydraulic Descaling Units in Rolling Mills.** Wolfgang Berns. *Stahl und Eisen,* v. 77, May 2, 1957, p. 567-576.

Design of descaling units in a Steckel mill, a continuous rolling mill for medium strip and a heavy plate rolling mill; number and sites of the jets; measurement and control of the hydraulic equipment; dimensions and operation of nozzles; electric current and water consumption. (W23, 1-22, L10g)

**211-W.** (Italian.) **Studies and Research on Heat Resistant Alloys and Their Use in Gas Turbines.** Federico Bragoni. *Calore,* v. 28, Feb. 1957, p. 55-70.

Problems of selection of materials for gas turbines. Work done in Europe, Great Britain and U.S. in development of these steels; composition and characteristics, with special reference to Sirius, Virgo and Nimonic steels. 19 ref.
(W11m, 17-7; SGA-h)

**212-W.** (Italian.) **Automatic Control of Blast-Furnace Gas Cleaning Plant With Four Blowers.** R. Porlezza and M. Valussi. *Metallurgia Italiana,* v. 49, Apr. 1957, p. 290-294.

Hydraulic control equipment distributes the load uniformly among four gas blowers. (W17n, 1-2)

**213-W.** (Swedish.) **Core Material for the Cores of Steel Plant Ingot Molds.** J. Brickner. *Gjuteriet,* v. 47, Feb. 1957, p. 23-24.

Core material bound with cellulose derivative gives total separation of the core from the ingot after only a few minutes.
(W19c, 17-7; ST)

**214-W.** (Book.) **Arcs in Inert Atmospheres and Vacuum.** Edited by W. E. Kuhn, 188 p. 1956. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $7.50.

Papers presented at the Symposium on Arcs in Inert Atmospheres and Vacuum of the Electrothermics and Metallurgy Division of the Electrochemical Society, Apr. 30 and May 1, 1956, at San Francisco, Calif. Covers inert atmospheres and vacuum furnaces, arc properties, effects of magnetic stirring, electrode requirements, melting rates of copper, iron, titanium, molybdenum, hign intensity arcs. Papers separately abstracted. (W18)

**215-W.** (Book—German.) **Construction and Operation of Cupola Furnaces. Vol. 1.** Leopold Schmid. 163 p. 1956. VEB Wilhelm Knapp Verlag, Mühweg 19, Halle (Saale), C2, Germany. DM 11.

Topics discussed include: development of smelting technique, construction of furnace and auxiliary equipment. Bibliography. (W18d)

**216-W.** (Book—German.) **Construction and Operation of Cupola Furnaces. Vol. 2.** Leopold Schmid. 219 p. 1953. VEB Wilhelm Knapp Verlag, Mühlweg 19, Halle (Saale), Germany. DM 9.60.

Raw materials, fuels, furnace agents, chemical and physical processes in the stack, measurement and composition of iron ingredients. Bibliography. (W18d, E10; Fe)

# X Instrumentation

Laboratory and Control Equipment

**44-X. Construction and Operation of a Laboratory Scale Arc Melting Unit.** J. F. Kuchta and S. Isserow. Nuclear Metals, Inc. *U.S. Atomic Energy Commission,* NMI-1142, Feb. 13, 1956, 18 p.

A unit, small enough for laboratory use, was needed for the melting of pure metals or experimental alloys requiring higher temperatures than those readily obtainable in resistance-type furnaces. The arc-melting unit was assembled for rapid melting of small specimens for various tests. The unit is flexible and has also been used for the sealing of the ends of tubes. (X24f, 1-3)

**45-X.** (German.) **New Controls in Melting Operations.** E. A. Hohmann. *Giesserei-Praxis,* v. 75, Feb. 25, 1957, p. 81-82.

Use of radioactive isotopes in the feeding of raw materials into the furnace to obtain a constant level. Electronic and photo-electric control circuits for furnaces are described. (X13, S18q, C5, 1-2)

**46-X. A Ferrous-Inclusion Detector for Aluminum Rod.** W. Frazer and M. O. Holt. *Nondestructive Testing,* v. 15, Mar-Apr. 1957, p. 96-97.

Ferrous-inclusion detector has been developed to detect inclusions of a size that may become a nuisance on the wiredrawing machine. Detector gives an audible and visual signal to the operator at the coiling end of the rod mill whenever an inclusion is detected.
(X8, F27; Al, *Fe,* 9-19)

**47-X.** (French.) **Regulation Systems in Electric Arc Furnaces.** J. G. Robin. *Metallurgie et la Construction Mecanique,* v. 89, Apr. 1957, p. 359-363.

Importance of regulation in the electric arc furnace; various regulation systems; regulation with constant impedance; with electric control; with hydraulic control.
(X10, W17j, 1-2)

**48-X.** (Italian.) **Temperature Measurement and Control in Industrial Heat Treat Ovens.** Engineering Staff of ISML (Light Metals Experimental In-

stitute). *Alluminio,* v. 26, Mar. 1957, p. 127-132.

Description and function of thermostats, heat stabilizers, thermocouples, load temperature measuring devices for heat treatment of light alloys. 8 ref. (X9, W27, 1-3; Al)

49-X. (Swedish.) **Apparatus for the Determination of Hydrogen in Steel.** Lars Bjerkerud. *Jernkontorets Annaler,* v. 141, no. 2, 1957, p. 90-94.

Main component is a quartz tube in three sections: a heater, a water coolant and a graduated burette. Heating is by high frequency coil or sliding resistance. 4 ref. (X21, 1-2, S11; ST, *H*)

50-X. **Study of Permanent Magnets of the Barium Ferrite Type.** K. J. Sixtus. Indiana Steel Products Co. (Wright Air Development Center). *U.S. Office of Technical Services,* PB 121865, Aug. 1956, 53 p. $1.50.

More than 700 magnets were prepared and measured. Data are provided in the report for processes for making the magnets, methods and results of physical measurements, and observations on theoretical aspects of magnetism in barium ferrite. (X11g, 17-7, P16; Ba, Fe)

51-X. (Czech.) **X-Ray Monochromator for Quantitative Determination of Structural Constituents.** Frantisek Khol. *Hutnické Listy,* v. 122, Apr. 1957, p. 299-302.

Design of a simple quartz monochromator which can be used with X-ray tubes. The procedure for quantitative determination of (martensite, cementite, austenite) structural constituents in carburizing and carbonitriding layers of carbon steels is given. 8 ref. (X3, M23, N8; CN)

52-X. (German.) **Electrolysis Tube, a New Apparatus for Metallographic Inspection.** L. G. Damgaard and E. Knuth-Winterfeldt. *Metalloberfläche,* v. 11, Mar. 1957, p. 75-76.

Apparatus for the metallographic inspection of metal surfaces on the spot. Spots up to 8 mm. diam. can be electropolished, and a replica can be taken for microscopic inspection. (X4, 1-3)

53-X. (German.) **Apparatus for Measuring the Depth of Cracks.** Lutz Brand. *Stahl und Eisen,* v. 77, May 2, 1957, p. 576-581.

Apparatus for the determination of the depth of cracks at the surface of metals with the use of direct or alternate current; calibration curves of the apparatus; variables influencing the scatter range of the curves; comparison of the measured results with the depth of cracks. (X8, 1-2, 9-22)

54-X. (German.) **How to Measure the Roughness of Technical Surfaces With Conventional Inductive Instruments.** Hugo Philipp. *Werkstatt und Betrieb,* v. 90, May 1957, p. 277-280.

New measuring arrangement for determining the surface roughness, for which purpose conventional induction instruments, measuring bridges, and registering apparatus were connected to form a functional unit. Apparatus was especially developed for measuring the roughness of gas cut surfaces, but it can also be used for other metal surfaces. (X23p, 1-3)

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METALLURGICAL OR CHEMICAL ENGINEER: Large metal fabricating company has excellent opening in metallurgical department for aggressive, alert individual, 22 to 35 years old. Applicants should have some experience in metal production processes and mill problems in aluminum fabrication, including casting, rolling, drawing or extrusion. Include in reply complete details concerning education, experience, salary desired. Box 7-15.

METALLURGIST: Capable of running small modern nonferrous smelting plant in Eastern Pennsylvania. If you have had any experience in making brass, bronze and aluminum alloys from scrap, please advise us. Salary will be more than liberal for the right man. Box 7-20.

PROFESSORIAL CHAIR, METALLURGY OR PHYSICS OF METALS: No administrative assignments. Starting salary $15,000 per year. September 1958 appointment. Recommendations as well as applications solicited. Box 7-25.

TEACHER: In expanding metallurgical engineering department of privately endowed college offering engineering and liberal arts degrees. Rank and salary open. Reasonable teaching load. Position open Sept. 1, 1957. Location and facilities attractive for man to engage in consulting and research. Graduate studies offered at nearby locations. Box 7-130.

### Midwest

MATERIALS ENGINEER: Metallurgical background, to investigate plant equipment failures, recommend materials and methods for chemical plant service, evaluate and apply new materials of construction, and act as consultant on materials problems. Prefer one to five years experience. Furnish complete details on training and experience. Box 7-30.

### Northwest

HEAD OF METALLURGY DEPARTMENT: Ph.D. in physical or extractive metallurgy, or chemical engineer experienced in metallurgy, to head department of metallurgy, Montana School of Mines. To start September 1957. For details write: F. A. Hames, Montana School of Mines, Butte, Mont.

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ASSISTANT PROFESSORSHIP IN METALLURGY: University faculty position open for young man interested in teaching metallurgical subjects in fields of extractive and physical metallurgy. Real opportunity for one interested in joining staff of expanding educational and research program centered in the mild, dry pleasant climate of a clean and growing city. One and one-half million dollar building to be constructed to accommodate expansion affecting geological, metallurgical and chemical engineering. Box 7-35.

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WELDING ENGINEER: B.S. in welding engineering, Ohio State University. Interested and experienced in carbon and alloy steel fabrications, also nonferrous. Thoroughly familiar with automatic welding. Experienced and successful in industrial welding sales. Age 30, willing worker, proven leadership ability. Box 7-40.

METALLURGIST: B.S. degree, married, family, veteran. Eight years research and de-

velopment experience in ferrous and nonferrous fields, including high-temperature alloys. Background includes nuclear metallurgy and laboratory supervision. Seeks metallurgical position in Connecticut but will consider other locations. Box 7-45.

METALLURGIST: B.S. degree, age 41, with 17 year experience in foundry, heat treating, plating, welding, machining and testing of ferrous and nonferrous metals, vitreous enameling and organic finishes. Chief metallurgist for seven years in aircraft industry. Desires position with opportunity and challenge in the aircraft industry or related field. Box 7-50.

METALLURGIST: B.S. degree, married, family, veteran. Six years experience in research, development and industrial problems.

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To head up completely modern laboratory and supervise present experienced technicians, cooperate in furnace testing projects, prepare photographs, reports on lab work, etc. Three or four years of experience since graduation is desirable. ASM participation is a must.

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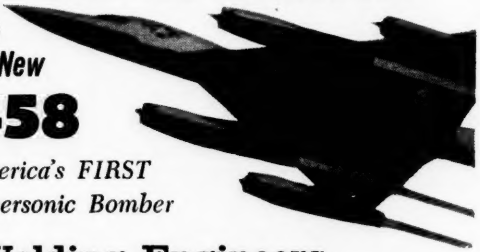

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Desires position with manufacturing firm involving production or products development. Box 7-55.

METALLURGIST: B.S. degree, age 39, married, 12 years diversified experience, including material selection and inspection, machining and fabricating problems, heat treating, brazing, plating, process control and failure analysis. Duties included supervision and administration of departments, development work, consultation with engineering, manufacturing and marketing personnel. Can handle people well and get along with co-workers. Box 7-60.

METALLURGIST: B.Ch.Eng., M.S. degrees, age 28. Requirements for Ph.D. to be completed in Fall 1957. Thesis on creep-fracture. Desires position in basic and applied research dealing with problems of development and application of high-temperature materials. Prefers Northwest but will consider other locations. Box 7-65.

METALLURGICAL ENGINEER: Prefers Michigan. Six years diversified aircraft experience in process and product control and development of ferrous and nonferrous materials. Age 31, B.S. degree, married, family. Desires position with reliable and progressive company. Box 7-70.

METALLURGIST: Degree, some advanced studies including 15 years part-time teaching

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**CRUCIBLE STEEL CO. OF AMERICA**

**Central Research Laboratory**
**Pittsburgh, Pennsylvania**

**MECHANICAL ENGINEER**

Requires advanced degree in mechanical engineering or metallurgy with experience in both technical disciplines. Should have a minimum of ten years' experience in development of metal working processes and equipment. Competence in handling engineers associated with the working of metals is desirable.

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of metallurgy, age 40, married. Wide experience in fabrication, heat treating and surface treating of metals, and as laboratory supervisor and plant metallurgist. Desires metallurgical administrative position with greater responsibilities in a progressive organization in the Cleveland area. Box 7-75.

METALLURGICAL ENGINEER: B.S. degree, University of Pittsburgh, age 30, married, veteran. Seven years experience with major manufacturer of pipe and tubing including labor on blast furnace, blast furnace research; 3½ years in pipe mill, including working in control, developments and failure analysis; 1½ years as claim analyst in sales. Currently employed as turn supervisor of chemical and physical laboratories in tubing specialties mill. Wishes to relocate. Complete resume upon request. Box 7-80.

HEAT TREATER: Married, family, veteran, age 36. Over 15 years experience with same company in heat treating of low, medium and high carbon steel. Annealing liquid salt bath, liquid carburizing, electric furnace and induction heat treat experience, can straighten shafts. Presently employed but desires job with future. Box 7-85.

METALLURGIST: M.S. degree, age 42, married, family. Five years in fundamental ferrous research, eight years in aircraft engine research and development. Experienced in physical metallurgy of alloy steels, heat resistant alloys, titanium, evaluation, failure analysis, alloy and processes development, application of materials and processes to production and advanced experimental engines. Supervisory and administrative experience. Publications. East preferred. Box 7-90.

METALS SALES OR SALES TRAINEE: Position desired by family man, age 28, B.S. in business administration. Two years experience as metallurgical technician in aluminum foundry, two years as materials specification writer. Resides in Southern Connecticut, willing to relocate. Box 7-100.

METALLURGICAL ENGINEER: Age 27, married, two children. Desires challenging position with growth potential, North or West. Excellent college record, some graduate work. Three years experience involving administrative and technical procurement responsibilities, research work and technical writing as staff engineering officer in the United States Navy. Box 7-105.

METALLURGICAL ENGINEER: Hungarian freedom fighter, now residing in Canada, age 27, single. Masters degree in metallurgical engineering from technical university in Hungary, accepted by Association of Professional Engineers, Toronto. Three years experience in openhearth steelmaking but will consider other fields. Speaks German and Italian, some English as well as Hungarian. Box 7-110.

REGISTERED PROFESSIONAL ENGINEER: Experienced as supervising engineer in charge of manufacturing process equipment, aircraft and allied products. Director of laboratory and chief sales engineer in charge of applied research, old and new lines, metal forming presses, established nondestructive quality control. Chief product engineer, pneumatic and hydraulic components. Prefers sales but will consider creative, engineering management position. Box 7-115.

MECHANICAL ENGINEER: Degrees and certificates in mechanical engineering, toolmaking, electronics, machinery production. Owned tool shop in Europe, 1927 to 1949. Married, family, recently arrived from Europe. Over 60 international patents on tools, automation devices, etc. Speaks German, Hungarian, limited English being improved by accelerated 8-hr. day course at present. Over 30 years broad experience in all phases mechanical engineering. Desires consulting work, manufacturing trouble shooting, solving problems in large factories, machine tool problems. Box 7-125.

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Exhibitors do not need to be members of the American Society for Metals.

Work which has appeared in previous metallographic exhibits held by the American Society for Metals is unacceptable.

Photographic prints should be mounted on stiff cardboard; maximum dimensions 14 by 18 in. (35 by 45 cm.). Heavy, solid frames are unacceptable.

Entries should carry a label on the *face* of the mount giving:

Classification of entry.

Material, etchant, magnification.

Any special information as desired.

The name, company affiliation and postal address of the exhibitor should be placed on the back of the mount.

Entrants living outside the U. S. A. should send their micros by first-class letter mail endorsed "Photo for Exhibition—May be Opened for Customs Inspection".

Exhibits must be delivered before Oct. 15, 1957, either by prepaid express, registered parcel post or first-class letter mail, addressed:

**Metallographic Exhibit**
**American Society for Metals**
**7301 Euclid Ave.**
**Cleveland 3, Ohio, U.S.A.**

### CLASSIFICATION OF MICROS
*(Optical and Electron)*

Class 1. Irons and steels.
Class 2. Stainless steels and heat resisting alloys.
Class 3. Aluminum, magnesium, beryllium, titanium and their alloys.
Class 4. Copper, nickel, zinc, lead and their alloys.
Class 5. Uranium, plutonium, thorium, zirconium and reactor fuel and control elements.
Class 6. Metals and alloys not otherwise classified.
Class 7. Series showing transitions or changes during processing.
Class 8. Welds and other joining methods.
Class 9. Surface coatings and surface phenomena.
Class 10. Results by unconventional techniques (other than electron micrographs).
Class 11. Slags, inclusions, refractories, cermets and aggregates.
Class 12. Color prints in any of the above classes. (No transparencies accepted.)

### AWARDS AND OTHER INFORMATION

A committee of judges will be appointed by the Metal Congress management which will award a First Prize (a medal and blue ribbon) to the best in each classification. Honorable Mentions will also be awarded (with appropriate medals) to other photographs which, in the opinion of the judges, closely approach the winner in excellence. A Grand Prize, in the form of an engrossed certificate and a money award of $100, will also be awarded the exhibitor whose work is judged best in the show, and his exhibit shall become the property of the American Society for Metals for preservation and display in the Society's national headquarters in Cleveland.

All photographs may be retained by the Society for one year and placed in a traveling exhibit to the various Chapters. They will be returned to the owners in May 1958 if so desired.

## The Twelfth Metallographic Exhibit

**Chicago, Illinois, November 2 to 8, 1957**